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CANADIAN MINERALS YEARBOOK

Canada

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CANADIAN MINERALS YEARBOOK

2002 Review and Outlook

Canada

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Preface

Each year, the Minerals and Metals Sector of Natural Resources Canada undertakes a comprehensive review of developments in the mineral industry and publishes the results as the *Canadian Minerals Yearbook*. This publication forms a continuing record from year to year, with this edition reporting on the activities of the industry during 2002 (some events in 2003 may be referenced).

The main focus of this publication is the non-fuel mineral industry, together with uranium and coal, although all mineral fuels are normally included when the total value of Canada's mineral production and other comprehensive statistics are reported. The Yearbook includes chapters devoted to each major mineral commodity produced in Canada. The subject matter spans all stages of mineral industry activity from geoscience and exploration, through mining and processing, to markets and use. Although domestic issues receive the greatest attention in each chapter, international developments may also be reviewed because of the global nature of the mineral industry and the significant impact that such developments could have on the Canadian industry.

The Yearbook's first chapter, entitled "General Review," highlights the importance of the industry in the context of the Canadian economy. In 2002, the non-fuel mineral industry accounted for approximately 2.9% of total national employment, 3.7% of Canada's Gross Domestic Product, and 13.6% of Canada's domestic exports. The General Review is followed by chapters that focus on the Canadian scene with reviews on mine reserves and recent production decisions; mineral exploration and discoveries; and mine openings and closings. Chapters that detail Canada's global mining presence abroad and outline developments on the international scene are also included, as well as a new chapter this year entitled "Canada's Historical Mineral Production."

The 22 commodity reviews in this year's edition feature economic and policy developments and data specific to each commodity in respect of markets, prices, production, trade and use. These commodity chapters also provide an outlook on the industry's future position.

The Statistical Report at the end of the Yearbook is a comprehensive set of tables that provide a detailed statistical overview of the mineral industry. These tables are grouped according to the following topics: production; trade; use; prices; principal statistics; employment, salaries and wages; mining and exploration; transportation; and investment and finance. Although the tables focus on the most recent data available, many of the tables also include historical statistics.

The basic statistics on Canada's mineral and metal production, trade and use were collected by the Minerals and Mining Statistics Division of Natural Resources Canada, or by Statistics Canada, unless otherwise noted. Market quotations were taken mainly from published marketing reports. Corporate data presented in the various chapters of this Yearbook were obtained by the authors directly from company officials through surveys or correspondence, or were taken from web sites and annual reports. Natural Resources Canada is grateful to everyone who has contributed information used in the preparation of this publication.

Additional copies of the 2002 Yearbook may be purchased from the Geological Survey of Canada Bookstore (telephone [613] 995-4342 or 1-888-252-4301 [toll free], or e-mail gscbookstore@nrcan.gc.ca) and local booksellers. Previous editions of the *Canadian Minerals Yearbook* have been deposited in various libraries across Canada.

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Note: Previous and current commodity reviews prepared by the Minerals and Metals Sector since 1994 are also available on our web site at:

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Updates will be posted as they become available.

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Note: Commodities shown in **bold** type are covered in this issue. The other commodities listed have appeared in previous editions for which the most recent year is indicated in parentheses.

Canadian Minerals Yearbook

2002 Review and Outlook

NOTE TO READERS

The intent of this publication is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The authors and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this publication.

ABBREVIATIONS

A number of abbreviations for common units of measurement may appear in the text:

A$	Australian dollars
C$	Canadian dollars
US$	U.S. dollars
cm	centimetres
ct	carats
dmt	dry metric tonnes
€	euro, European currency
f/cm^3	fibres per cubic centimetre
ft	feet
g	grams
GJ	gigajoules
GWe	gigawatts electric
h	hour
ha	hectares
hp	horsepower
ht	hundred tonnes
in	inches
kg	kilograms
km	kilometres
km^2	square kilometres
kVA	kilovolts ampere
kW	kilowatts
kWe	kilowatts electric
kWh	kilowatt hours
L	litres
lb	pounds
m	metres
M	million
m^2	square metres
m^3	cubic metres
mg	milligrams
mm	millimetres
Mt	million tonnes or megatonnes
MW	megawatts
oz	ounces
ppm	parts per million
st	short tons
t	tonnes
y	year
µg	micrograms
µm	micrometres

Note: All dollar figures in the text are Canadian unless specified otherwise.

General Review

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OVERVIEW

Global economic activity was mixed in 2002 as most economies experienced uneven and choppy performances. Global Gross Domestic Product (GDP) was estimated at 3.0% growth, up from 2.3% in 2001. However, business investment continued to be weak and consumer spending, although buoyant, slowed relative to its strong performance of the past several years. Part of the general economic malaise and uncertainty was due to the fall-out from the terrorist attacks in the United States on September 11, 2001, the subsequent global war on terrorism and, late in the year, international tensions over Iraq. Consequently, the global mineral industry experienced a continuation of sluggish demand and excess capacity resulting in relatively weak prices for most mineral commodities. A notable exception was gold, which benefited from the global political tensions and economic uncertainties to post significantly higher prices during the year.

Canada's real GDP, measured at market value in 1997 prices, increased by 3.3% in 2002 to $1.07 trillion, compared to a growth rate of 1.9% in 2001. Both interest rates and inflation remained low, but pressures in the Canadian economy pushed both to levels higher than in 2001. The average annual unemployment rate rose to 7.7% and the value of the Canadian dollar vs. the U.S. dollar averaged $0.6368, down slightly from 2001. Total Canadian merchandise exports (Customs basis) decreased to $396.3 billion, down by 1.9% from $404.0 billion in 2001 and $413.2 billion in 2000. Imports (Customs basis) totaled $348.4 billion, compared to $343.1 billion in 2001 and $356.9 billion in 2000.

Preliminary estimates for the value of production[1] for all sectors of the Canadian mining and fuel extraction industry totaled $77.0 billion, down 7.3% from $83.0 billion in 2001 and the record high of $83.8 billion in 2000. The fuels sector declined as prices for natural gas and natural gas by-products fell. When fuels are excluded, the value of production for the mining industry remained flat at $18.0 billion. Of this, metal production declined by 1.3% to $10.2 billion while nonmetallic production increased by 1.8% to $7.8 billion.

The value of total exports for non-fuel mining and mineral processing products (including coal) increased by 4.3% to $51.0 billion. The 2002 export figure represents 12.9% of Canada's total exports. Canadian imports of non-fuel mining and mineral processing products (including coal) totaled $48.5 billion, up 3.8%. As a result, the balance of trade (total exports minus imports of these commodities) showed a surplus of $2.4 billion.

Prices for many of the major mineral commodities were relatively weak and flat in 2002, although there were notable exceptions. Of the major nonferrous metals, nickel and copper were higher at year-end compared to the start of the year, whereas zinc, lead and aluminum were lower. For precious metals, gold and platinum were up significantly during the year, silver was up marginally, and palladium was down sharply.

Significant developments affecting the Canadian mining industry in 2002 included:

- Corporate operating profits falling for the second year in a row;

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[1] Throughout this article, the volume and value of production are based on estimates using shipments from domestic sources as the measure of mine production, as published in *Canada's Mineral Production, Preliminary Estimates*, Statistics Canada, cat. no. 26-202-XIB. Foreign ores, e.g., bauxite, are therefore not included.

- Exploration activity being up for the second consecutive year;
- The Government of Canada implementing legislation to meet its obligations under the Kimberley Process Certification Scheme for rough diamonds;
- Consolidation of virtually all metallurgical coal operations in Canada under the agreement to form the Fording Canadian Coal trust;
- The revival of the Voisey's Bay nickel project as Inco Limited and the Government of Newfoundland and Labrador came to agreement on its development;
- The Diavik diamond mine, Canada's second diamond project, completing advanced pre-development work and moving towards an early 2003 start-up;
- Decreased employment in mining; and
- Mine openings that equaled mine closings.

The outlook for the global economy in 2003 is clouded by many factors, notably significant geopolitical tensions and under-performing economies around the world. Higher energy prices were also beginning to dampen economic activity in late 2002 and early 2003. Global GDP growth in 2003 is expected to continue, albeit at a relatively subdued rate. These factors also bring uncertainties to mineral commodity markets. With the exception of some mineral commodities, such as gold, which is viewed by many as a haven for investment in times of trouble, and nickel, with increasing demand now evident in China and Asia, most commodity activity will likely remain sluggish and lacklustre in 2003. Therefore, until the uncertainties are diminished and capital investment spending firms up, the demand for mineral commodities will likely remain soft and unclear. If so, negative impacts can be expected on the operating and financial performance of most mining companies, including Canadian companies, in 2003.

THE CANADIAN ECONOMY

The Canadian economy exceeded initial expectations in 2002 as GDP grew by 3.3%, compared to 1.9% in 2001, notwithstanding global geopolitical, financial and economic weaknesses. The economy was particularly strong in the first six months of the year before softening to an annualized growth rate of 1.6% in the last quarter. Capacity utilization for the last quarter of the year was 82.9% (manufacturing at 84.3%), compared to 81.7% (manufacturing at 82.1%) for the first quarter of 2002. Inflation and interest rates remained at low levels, even though some inflationary pressures were present during the year.

In response to these market conditions, the Bank of Canada lowered its target overnight rate by 25 basis points to 2.00% in January, but later raised the rate by 25 basis points in each of April, June and July to reach 2.75%. Rate announcements in September, October and December left the rate unchanged. For the year, the rate increased by 50 basis points from 2.25% to 2.75%. This increase contrasts with the United States where the federal funds rate fell from 1.75% at the beginning of the year to 1.25% at year-end. Thus, there was a spread of 1.5% between the key U.S. and Canadian rates as 2002 came to a close. The annual inflation rate (Consumer Price Index) remained in the Bank of Canada's annual target range of 1-3%, averaging 2.2% in 2002, down from 2.6% in 2001 and 2.7% in 2000. The value of the Canadian dollar vs. the U.S. dollar averaged $0.6368, down from $0.6458 for 2001. This represents a 1.4% decline and continues the trend of the 1990s when the dollar lost nearly a third of its value.

Consumer spending continued to be robust in 2002. Canada Mortgage and Housing Corporation announced that new housing starts increased by 26.0% to 205 034 units in 2002 as homebuyers took advantage of continuing lower mortgage interest rates and improved employment opportunities. Similarly, the Canadian Real Estate Association reported that existing house sales across Canada on the Multiple Listing Service increased by 10.6% in 2002 to reach 421 227, an all-time high. Overall, building construction was strong as Statistics Canada announced that the value of building permits reached $46.0 billion in 2002 in real terms, the highest since 1989 and an increase of 16.2% over 2001. Of this total, residential permits accounted for $29.1 billion.

Automotive companies reported that new vehicle sales in Canada rose to a record 1.7 million in 2002, an increase of 8.5% over 2001, due in part to a continuation of the strong buyer incentives, including zero interest financing, introduced to maintain sales following the September 11th

CANADIAN ECONOMIC CONDITIONS

Leading Indicators	2001	2002	% Change
Real GDP ($ billions, 1997 chained prices)	1 040.40	1 074.5	+3.3
Consumer prices (% annual change)	+2.0	+2.7	n.a.
Operating profits ($ billions)	138.6	146.3	+5.6
Unemployment rate (% annual average)	7.2	7.7	+6.9
Merchandise trade balance (balance of payments basis) ($ billions)	64.0	54.6	n.a.
Housing starts (000)	162.7	205.0	+26.0
Canada/U.S. exchange rate (annual average)	0.6458	0.6368	-1.39
International current account balance ($ millions)	26 864	23 366	n.a.
Global economic output (% change)	+2.3	+3.0	n.a.

Sources: Statistics Canada: Canada Mortgage and Housing Corporation; International Monetary Fund.
n.a. Not applicable.

terrorist attacks in 2001. Of this total, passenger car sales rose 7.5% to 934 000. On the production side, automotive manufacturers in Canada produced 1.35 million passenger cars in 2002, up 4.1% from 2001.

The average annual unemployment rate rose to 7.7% in 2002 from 7.2 % in 2001, even though employment rose by 3.7%, or 560 000, the highest annual growth rate since 1987. This compares to employment growth of 0.2%, or 25 000, in 2001 and 2.2%, or 325 500, in 2000.

On the trade front, total Canadian merchandise exports fell to $396.3 billion from $404.0 billion in 2001, a decline of 1.9%. In 2000, exports totaled $413.2 billion. The trade surplus (exports minus imports) declined to $47.9 billion, compared to the $60.9 billion trade surplus in 2001 and $56.3 billion in 2000. Imports totaled $348.4 billion in 2002 compared to $343.1 billion in 2001 and $356.9 billion in 2000.

Global economic activity (GDP) increased in 2002 by 3.0%, up from 2.3% in 2001 but down from 4.4% in 2000 and 3.7% in 1999. The U.S. economy rose by 2.4% in 2002 compared to only 0.3% in 2001. The European Union declined from 1.4% growth in 2001 to 0.8% in 2002 while the United Kingdom fell from 2.0% to 1.6%, France from 1.8% to 1.2%, and Germany from 0.6% to 0.2%. Japan declined from 0.4% growth in 2001 to 0.3% in 2002. China rose from 7.3% in 2001 to 8.0% in 2002 while South Korea rose from 3.0% growth in 2001 to 6.1% in 2002.

THE CANADIAN MINERAL INDUSTRY

The Canadian mineral industry can be characterized by the following four stages of processing activity:

- Stage 1: Mineral extraction and concentrating industry (for example, gold mining, and sand and gravel/quarrying);
- Stage 2: Smelting and refining industry (for example, nonferrous smelting and refining, alloying, and the production of primary steel);
- Stage 3: Nonmetals and metals-based semi-fabricating industries (for example, copper rolling, casting and extruding, and concrete products); and
- Stage 4: Metals fabricating industries (for example, manufacturing of ornamental metal products and machine parts).

While much of this article focuses on Stage 1 activities (the activities of the mining industry), a description of the mineral industry as a whole (Stages 1 to 4) provides a more comprehensive picture of its importance to Canada. In the context of this article, the mineral industry should be taken to exclude the extraction and processing of crude petroleum and natural gas, but to include both the coal and uranium mining industries.

CANADIAN MINERAL INDUSTRY IN 2002

Leading Mining Indicators	2001	2002	% Change
Value of mineral production (excluding oil and gas) ($ millions)	19 534	19 570	+0.19
Exploration expenditures ($ millions)	513	573	+11.8
Metal Price Index (1997=100)			
Precious metals	83.3	94.3	n.a.
Base metals	73.9	74.5	n.a.
Direct mining employment (000)	50.5	47.4	-6.1
Value of minerals and mineral products domestic exports ($ billions)	47.4	49.6	+4.5
Mining company operating profits ($ billions)	2.3	1.6	-30.6
Worldwide mine equity financing ($ billions)	4.4	10.5	+137.6

Sources: Natural Resources Canada; Statistics Canada; Gamah International.
n.a. Not applicable.
Note: All the indicators above, with the exception of the Metal Price Index and mining company operating profits, include the coal mining industry.

GDP OF THE MINERAL INDUSTRY

In 2002, the mineral industry, as defined above, contributed $36.4 billion to Canada's total GDP, an increase of 3.1% over 2001, or 3.7% of Canada's total GDP of $977.6 billion. (In this section, all figures are based on GDP at basic prices in chained 1997 dollars.) Mining (mineral extraction and concentrating – Stage 1) contributed 26.0% of the industry's GDP in 2002 while smelting and refining (Stage 2) added a further 21.7% to the total. Nonmetals and metals-based semi-fabricating (Stage 3) accounted for 21.0% and metals fabricating (Stage 4) accounted for the remaining 31.4%.

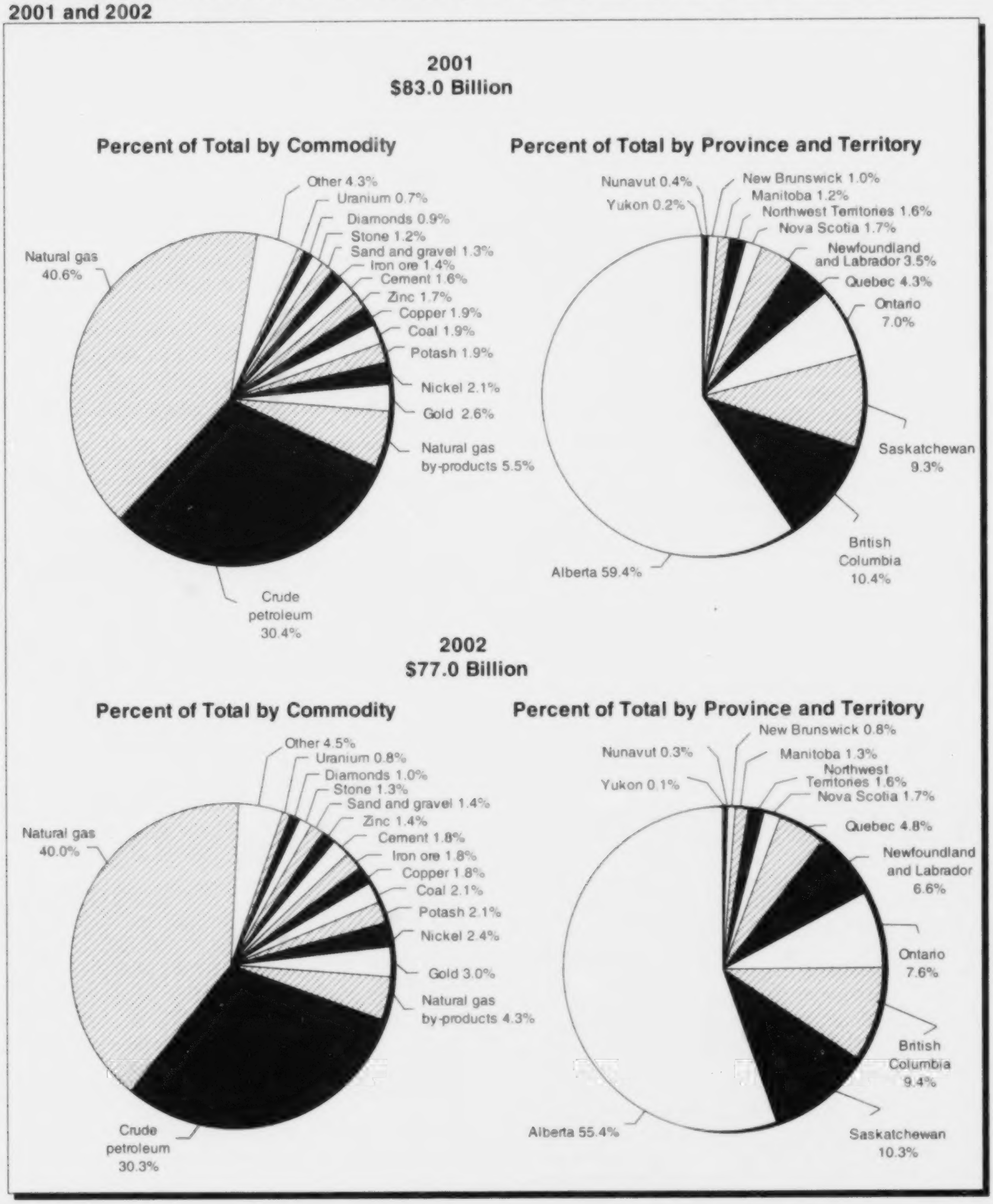
For mining (Stage 1) in 2002, GDP dipped by 0.2% to $9.5 billion as coal mining decreased by 12.3% to $988 million and metal mining decreased by 5.8% to $5.0 billion. Nonmetals and quarries rose by 9.7% to $3.2 billion. GDP for services related to mining and oil and gas fell by 20.0% to an estimated $4.1 billion in 2002.

CANADIAN MINERAL PRODUCTION

Production From Canadian Mines, Quarries and Oil/Gas Wells

Based on preliminary estimates and using shipments as the measure of mine production, the total value of Canadian mineral production (including fuels) amounted to

Figure 1
Value of Mineral Production, Percent Shares by Commodity and by Province and Territory, 2001 and 2002



Sources: Natural Resources Canada; Statistics Canada.

Notes: The provincial/territorial shares may not add to 100% due to rounding. P.E.I. mineral production is too small to illustrate.

$77.0 billion, down 7.3% from $83.0 billion in 2001. In 2000, an all-time high of $83.8 billion was recorded. The value of production of the metals and nonmetals group remained unchanged in 2002 from 2001 at $18.0 billion, while a drop in prices for natural gas and its by-products resulted in a decrease of 9.3% in the total value of the fuels group to $59.0 billion.

The value of metals production fell by 1.3% to $10.2 billion in 2002 from $10.4 billion in 2001 as significant decreases occurred for the platinum group metals, cobalt, lead and zinc. Gold, nickel, copper, iron ore and zinc achieved values in excess of $1 billion. Gold was the only metal produced in Canada that had a value of production over $2 billion in 2002. It was Canada's leading metal with a value of $2.3 billion, an increase of 7.4% due entirely to higher prices as gold output fell by 6.9%.

Table 1 shows the value and volume movements of the major mineral commodities produced in Canada for the years 2001 and 2002.

The value of nonmetals production rose to a record high of $7.8 billion in 2002, an increase of 1.8% over 2001. Increases in the value of cement, stone, diamonds, clay products, lime, peat and gypsum more than offset decreases in the value of potash, sand and gravel, salt and asbestos. Production values in excess of $1 billion were recorded by potash, cement, and sand and gravel. Potash remained the leading nonmetal produced in Canada. The mining of potash accounted for $1.6 billion in value, a slight decline of 1.2% from 2001 as output was off by 0.6%.

The value of production for mineral fuels fell by 9.3% in 2002 to $59.0 billion from the record high of $65.0 billion reached in 2001. Falling natural gas prices in 2002 led to natural gas at $23.3 billion and natural gas by-products at $3.3 billion, a decline of 30.8% and 28.1%, respectively.

VALUE OF CANADIAN MINERAL PRODUCTION(1)

	2001 (r)	2002 (p)	Change
	($ millions)		(%)
Metallic minerals	10 359.3	10 225.1	-1.3
Nonmetallic minerals	7 617.2	7 751.8	1.8
Total non-fuels	17 976.5	17 976.9	–
Fuels	64 991.3	58 974.3	-9.3
Total minerals	82 967.8	76 951.1	-7.3

Sources: Natural Resources Canada; Statistics Canada, *Canada's Mineral Production, Preliminary Estimates*, 2002, cat. no. 26-202-XIB.
– Nil; (p) Preliminary; (r) Revised.
(1) The value of non-fuels production is based on shipments.
Note: Numbers may not add to totals due to rounding.

The volume of production of natural gas was the same as in 2001 while natural gas by-products were up by 0.8%. Increasing oil prices and higher output (up 5.8%) led to a sharp increase of 22.3% in the value of crude oil production to $30.8 billion in 2002. The value of coal increased by 2.3% to $1593.1 million as the result of higher prices since production fell by 5.0%.

Based on the value of production for 2002, the top non-fuel commodities were gold ($2.3 billion), nickel ($1.9 billion), potash ($1.6 billion), copper ($1.4 billion), iron ore ($1.4 billion), cement ($1.4 billion), zinc ($1.1 billion), and sand and gravel ($1.0 billion). In terms of the production of Canada's leading minerals, increases in mine output of 5% or greater were recorded by diamonds, iron ore, gypsum, silver, and platinum group metals, whereas declines of 5% or more were experienced by lead, asbestos, zinc, salt, gold and copper.

Geographically, the importance of the industry may be more significant on a regional and community basis as, in many parts of Canada, particularly in the North, it provides a major economic stimulus. Well over 100 communities were heavily reliant on mining in 1996 and approximately 600 000 Canadians lived in these communities.

Regionally, four provinces continued to dominate the value of Canada's non-fuel mineral output in 2002, accounting for 75.3% of the total. Ontario contributed the largest share of the non-fuel mineral output at 32.0% of the total value while Quebec contributed 20.5%, Saskatchewan, 12.8%, and British Columbia, 10.0%. For the other provinces and territories, Newfoundland and Labrador was at 5.4%; the Northwest Territories, 4.8%; Manitoba, 4.6%; New Brunswick, 3.5%; Alberta, 3.3%; Nunavut, 1.5%; Nova Scotia, 1.4%; and the Yukon, 0.2%. The value for Ontario increased by 2.1% to $5.8 billion, Quebec was up by 2.4% to $3.7 billion, Saskatchewan was down by 0.3% to $2.3 billion, and British Columbia was down by 6.2% to $1.8 billion. When coal is included, the value of Saskatchewan production rises to $2.5 billion, which is a decline of 0.2% from 2001, and the value of British Columbia production increases to $2.8 billion, which is a decrease of 1.8% compared to 2001.

Alberta is Canada's major fuels producer with a value of $42.0 billion in 2002, accounting for 71.3% of Canada's total. With the exception of uranium, Alberta produces a full complement of mineral fuels, including crude petroleum, natural gas, natural gas by-products, and coal. Other provinces with significant mineral fuels production are Saskatchewan at 9.6% and British Columbia with 9.2% of Canada's total. Newfoundland and Labrador accounted for 6.9% and the other provinces and territories accounted for the remaining 3.0%.

There were nine mine openings in 2002 (one new mine and eight re-openings) and nine mine closings (six mine closures and three suspensions). Given the size and type of the mines that were opened or closed, there was a balance in both the number and relative importance of these mines.

From 1997 to 2001, there had been more closings than openings each year. That trend was broken in 2002. If gold prices remain above US$320/oz, more mine openings than closings can be expected in 2003. The fact that the six permanent closings outnumbered the one new opening was, however, a negative factor. Nevertheless, the situation has improved compared to the previous four years and a recovery in mine development and mine openings appears to be on the way in Canada.

Provincially, one new mine opened in Ontario. Three mines re-opened in Quebec, two re-opened in Ontario, and one each in Saskatchewan, British Columbia and the Northwest Territories. There were two mine closures in Nunavut and one each in Nova Scotia, Quebec, Manitoba and Saskatchewan. The three suspensions occurred in Nova Scotia, Quebec and Saskatchewan.

Mineral and Metal Production From Recycled and Imported Materials

Annual statistical series of Canada's mineral production to date have only included the production and value of minerals and metals obtained from Canadian-mined ores and concentrates. Statistics on the production and value of recycled materials or minerals and metals obtained from imported ores, concentrates, and recycled minerals and metals have not been generally available, despite the fact that Canada is a major producer of metals, most notably aluminum, from imported ores. Work has started on the development of new statistical series to present information that will characterize the production of these materials in Canada.

MINERAL AND METAL COMMODITY PRICES

In general, mineral and metal commodity prices remained soft in 2002 with a few exceptions such as gold, platinum and nickel. On the demand side, global economic conditions remained weak and uneven with the notable exceptions of China and South Korea. Indeed, GDP for the world economy is estimated to have increased by 3.0% in 2002, up from 2.3% in 2001.

Of the major base metals, only nickel and copper finished 2002 at price levels higher than they started the year, whereas zinc, lead and aluminum ended the year with lower prices than at the beginning. On the supply side, there was rationalization of mine capacity for many commodities on a global basis, due in part to weak international commodity prices and the relative increased strength of local currencies against the U.S. dollar.

Based on trading on the London Metal Exchange (daily closings), nickel opened 2002 at US$2.65/lb with inventories at 19 188 t and finished the year at US$3.22/lb with inventories at 21 990 t. From its low at US$2.55/lb in early January, nickel hit its high in mid-July at US$3.50/lb. Prices reacted in response to stronger demand in major end-use nickel markets, particularly in Asia, and an indication of a tightening of supply at year-end. Stocks reached a low of 16 596 t in mid-April and peaked at 29 130 t in mid-June. Copper opened the year at US64.9¢/lb, decreased slightly to its low of US64.5¢/lb in early January, increased to its high of US76.6¢/lb in early June, and declined in the last half of the year to close the year at US69.7¢/lb. Positive price pressures were evident as copper use increased during the year, especially in China and South Korea, while production fell. Shortages in concentrates were having an impact on smelter and refinery production, particularly late in the year. Copper stocks began the year at 799 225 t, which was the low for the year and then increased to a high of 980 075 t in early May before declining to 856 400 t at year-end. Aluminum began the year at US60.1¢/lb, increased to US65.2¢/lb in late March, declined to a low of US57.9¢/lb in early October and finished the year at US59.8¢/lb. Even though usage levels increased, notably in China, primary aluminum production also increased, thus maintaining the surplus of supply and contributing to overall price weakness. Indeed, inventories increased steadily from 821 250 t (yearly low) at the beginning of the year to 1 301 075 t in early September before falling slightly to 1 242 700 t at the end of the year.

Zinc began 2002 at US34.7¢/lb, moved up to US38.2¢/lb in mid-March, and then declined to its low for the year of US32.9¢/lb in mid-August before inching up to US34.0¢/lb to close out the year. Although zinc use increased and production declined in 2002, a continuing large zinc supply surplus exerted downward pressure on prices. Stocks began the year at 433 350 t, the low for the year, peaked at 656 950 t in mid-November, and closed out the year at 651 150 t. The price of lead declined in 2002, ending the year at US19.1¢/lb, compared to US23.5¢/lb at the beginning of the year. Its high was US24.4¢/lb in mid-January while its low was US18.3¢/lb in early October. Lead use fell during the year, as did lead production, resulting in a global market that was relatively in balance. Inventories began the year at 97 700 t, decreased to a low of 97 400 t shortly thereafter in early January, reached their high in early August at 197 400 t, and then declined to finish the year at 184 025 t.

For precious metals, gold closed out the year at US$342.75/oz, up by 23.1% from US$278.35/oz at the beginning of 2002, even though jewellery demand was down. Investment-related demand factors were significant, notably poor equity markets, a reduction in gold producers' hedging, the weakness of the U.S. dollar in currency markets, and concern over a new war in the Persian Gulf. There was a significant late-year surge in December as gold hit its high for the year at US$349.30/oz as fears of a new Gulf War escalated. The low for the year was reached in early January at US$277.75/oz. Silver prices began the year at US$4.59/oz, hit a high of US$5.0975/oz in mid-July from a low of US$4.2350/oz in late January, and ended the year at US$4.6650/oz, even though global demand rose while production fell in 2002. During the year, China, the largest seller of official government silver, announced that it would be using two million oz of silver in 2002 to issue a series of commemorative coins. Following depletion of the silver stockpile by the United States Defense Logistics Center, the United States Mint received legislative authority to buy silver on the open market for its coinage program.

The price of platinum rose significantly in 2002 from US$481/oz at the beginning of the year to US$598/oz at year-end, an increase of 24.3%, due in large part to increased demand for platinum for use in automotive catalytic converters. The low was reached in early February at US$453/oz with the high achieved in late December at US$607/oz. Palladium began the year at US$434/oz, reached its peak in mid-January at US$435/oz, declined to a low of US$222/oz in late December, and ended the year recovering only slightly to US$233/oz as a result of excess supply in the marketplace. Because of the recent history of price volatility of this hard-to-procure metal, which is mainly supplied from Russia, major industrial users, such as automotive producers and dental alloy manufacturers, have been trying to become less dependent on palladium by using less of it and seeking alternatives. As well, many automakers are trying to reduce the use of platinum group metals in general.

For other mineral commodities, the spot price for uranium (U_3O_8) was quoted at US$10.20/lb at the end of 2002, an increase of more than 6% from US$9.60/lb a year earlier. During the same period, long-term contract prices for uranium increased from US$9.25/lb to US$10.50/lb, an increase of 13.5%. At year-end, high-grade cobalt was selling at US$6.50-$6.80/lb, up from a 15-year low of about US$6.10/lb in the fall, compared to US$6.80-$7.40/lb a year earlier. Potash was quoted at US$110-$115/t for standard grade f.o.b. Vancouver, compared to about US$128/t a year earlier. The price for sulphur, f.o.b. Vancouver, at the end of 2002 was US$32-$39/t, compared to US$15-$22/t at the end of 2001.

International coal and iron ore prices are largely determined by annual Japanese reference or benchmark contract pricing. On this basis, the coal price in 2002 for metallurgical coal (hard coking) increased by 12.7% to US$48.20/t f.o.b., while thermal coal (steaming coal) decreased by 16.4% to US$34.50/t f.o.b. Reference prices for iron ore fines and lump ore into the Japanese market decreased by about 2.4% to US28.28¢/long ton unit f.o.b. and by 5.0% to US36.13¢/long ton unit f.o.b., respectively. Iron ore pellet prices for European markets (CVRD benchmark pricing) were set with a decrease of 3.4% at US47.36¢/t unit f.o.b.

RESERVES

During 2001, Canadian reserves of copper, nickel, lead, zinc, molybdenum, silver and gold declined significantly. This continued the declining trend that began in the early 1980s for base metals and in the late 1980s for gold. Lead reserves decreased by 26%, zinc reserves decreased by 12%, gold reserves declined by 11%, copper reserves and silver reserves each decreased by 10%, nickel reserves decreased by 9%, and molybdenum reserves decreased by 2%.

EMPLOYMENT IN THE MINERAL INDUSTRY

Combined employment in the four stages of the mineral industry (including coal mining) is estimated to have reached 360 851 in 2002, up slightly from 359 489 in 2001 and 359 106 in 2000. The mineral industry thus accounted for approximately 2.9% of the national employment level of 12.5 million (full-time workers) in 2002.[2]

Employment in Stage 1 (metal, nonmetal [including structural materials] and coal mining) decreased by 6.1% to an estimated 47 423, down from 50 511 in 2001. Employment in metal mining decreased by 10.3% to 23 944, nonmetal mining remained nearly the same at 17 779, and coal mining fell by 5.5% to 5700 during 2002.

Employment levels for Stages 2 and 3 were lower in 2002 compared to the previous year. Employment in Stage 2 decreased by 4.5% to 51 465. Most of the employment decrease was in the smelting and refining of nonferrous metals. Stage 3 employment fell by 1.0% to 84 942 even though employment grew in some sectors, such as iron foundries, clay product and refractory manufacturing, and ready-mix concrete manufacturing. Stage 4 employment increased by 4.6% to 177 021 as employment gains were exhibited by all sub-groups, notably structural metal products, ornamental metal products, and stamped, pressed and coated products. The level of employment in the sector that provides support for mining, quarries, and oil and gas wells, such as drilling and exploration activities, increased by 6.9% to 53 726 in 2002. In 2002, the estimated number employed in mining diamond drilling was 1194, the same as in 2001. Because there is no establishment-based survey undertaken at this time either by Natural Resources Canada or by Statistics Canada for support activities to mining, these numbers should be viewed with caution.

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[2] These statistics take into account the change from the Standard Industrial Classification (SIC) based employment data to the North American Industrial Classification System (NAICS). This new classification standard is used by the three partners in the North American Free Trade Agreement (NAFTA), i.e., the United States, Mexico and Canada.

MINERAL INDUSTRY TRADE

Canada is one of the world's largest exporters of minerals and metals. The export of these commodities and more refined mineral products has a significant impact on Canada's overall merchandise balance of trade and, hence, on the national standard of living. In 2002, the value of domestic exports of minerals and mineral products, including fuels, decreased by 3.4% to $96.9 billion from $100.3 billion in 2001 (Table 2).

The United States was again by far the leading destination for Canada's total minerals and mineral product exports (non-fuel, but including coal) with $39.1 billion in 2002. This represented 77.0% of total exports with the European Union at 9.3%, Japan (Canada's second largest export country) at 3.6%, Mexico (Canada's thirteenth largest export country) at 0.7%, and all other countries at 9.5%. Exports to the top 20 countries accounted for 97.6% of total Canadian exports. Based on the four stages of production, the United States accounted for 37.8% of Stage 1 exports, 74.7% of Stage 2 exports, 91.5% of Stage 3 exports and 91.9% of Stage 4 exports.

The value of total domestic exports of metallic minerals and mineral products (four stages of production, excluding fuels) rose by 5.3% to $38.1 billion, compared to $36.1 billion in 2001. On a commodity basis, important increases in the value of exports were exhibited by gold (+22.3%), iron and steel (+10.3%), nickel (+3.4%) and aluminum (+3.3%). Notable decreases were shown by platinum group metals (-37.5%), copper (-12.5%), cobalt (-14.0%) and zinc (-1.3%). Two commodities, aluminum and iron and steel, accounted for 52.4% of these total exports in 2002. For Stage 1 metallic commodities only, total domestic exports increased by 1.9% to $3.6 billion in 2002. For individual metallic commodities in Stage 1, domestic exports declined for platinum group metals (-26.8%), copper (-19.0%) and zinc (-10.7%), while exports increased for gold (+95.3%), molybdenum (+77.8%) and iron ore (+14.2%). Three commodities, iron ore, copper and aluminum, represented 57.4% of all Stage 1 metallic exports in 2002.

The total value of domestic exports of nonmetallic minerals and mineral products (four stages) increased by 2.4% to $9.5 billion from $9.3 billion in 2001. Notable increases were experienced by potash and potassium compounds (+7.4%), nitrogen (+7.0%), cement (+5.7%) and diamonds (+2.8%), while decreases occurred for peat (-11.4%), salt and sodium compounds (-11.2%), and glass and glassware products (-8.7%). Three commodities, potash and potassium compounds, glass and glassware, and nitrogen, accounted for 47.2% of total nonmetallic domestic exports. For Stage 1 only, total domestic exports of nonmetallic commodities increased by 3.2% to $4.2 billion from $4.1 billion in 2001. Exports of note that increased were potash and potassium compounds (+7.4%) and diamonds (+0.6%). Important declines were seen for asbestos (-8.6%), peat (-4.7%), and sulphur and sulphur compounds (-0.3%). Potash and potassium compounds accounted for 56.7% of all Stage 1 nonmetallic domestic exports in 2002 while diamonds accounted for 18.1% of the total.

For mineral fuels, the total value of domestic exports fell by 9.5% to $49.6 billion in 2002 from $54.9 billion in 2001. Natural gas exports decreased by 26.6% to $18.8 billion while petroleum exports increased by 8.4% to $27.0 billion. Domestic exports of coal and coke fell from $2.0 billion in 2001 to $1.8 billion in 2002, a decrease of 7.5%. Of the total mineral fuels domestic exports (four stages), natural gas accounted for 37.9% and petroleum for 54.5%. Approximately 77.8% of all domestic exports of mineral fuels occur at Stage 1.

The value of total imports of minerals and mineral products, including fuels (four stages), increased by 1.2% to $65.1 billion in 2002 from $64.3 billion in 2001. Excluding fuels, but including coal, imports rose to $48.5 billion in 2002, up from $46.8 billion, an increase of 3.7%. Of this amount in 2002, shipments from the United States accounted for 66.5% of the total with the European Union accounting for 9.0%, Mexico for 3.5%, Japan for 2.6%, and all other countries for 18.4%. The top 20 countries accounted for 93.0% of total imports. For the four stages of production (excluding fuels, but including coal), total imports from the United States accounted for 68.4% of Stage 1 imports, 37.4% of Stage 2 imports, 68.3% of Stage 3 imports and 69.4% of Stage 4 imports.

The total value of metal imports rose to $38.8 billion in 2002 from $37.1 billion in 2001, an increase of 4.7%. Notable in 2002 were increases for gold (+23.8%), iron and steel (+8.4%) and aluminum (+3.5%), and decreases for platinum group metals (-26.3%) and copper (-12.8%). Two commodities, aluminum and iron and steel, accounted for 54.9% of all metal imports in 2002. For nonmetals, import values were down fractionally (-0.5%) to $8.3 billion from $8.4 billion in 2001. Commodities of note included declines for nitrogen (-25.5%) and glass and glassware products (-5.8%), and increases for diamonds (+20.6%) and clay and clay products (+11.8%). Two commodities, glass and glassware products and clay and clay products, accounted for 45.7% of total imports of nonmetals in 2002.

The balance of trade generated (total mining exports, including fuels, minus total mining imports, including fuels) decreased by 9.8% in 2002 to $34.0 billion. This trade surplus compares to $37.7 billion in 2001 and $31.6 billion in 2000. For the total Canadian economy, the trade surplus fell to $47.9 billion in 2002 (-21.4%) from $60.9 billion in 2001 and $56.3 billion in 2000.

INVESTMENT BY THE MINERAL INDUSTRY

Information on exploration expenditures and capital spending provides a useful indication of market conditions and of the perspectives that management and investors in the Canadian mining industry hold on future market conditions in relation to present productive capacity. At the end of 2002, there were 194 mining companies listed on the Toronto Stock Exchange with an aggregated market capitalization of some $107 billion. Twenty-two of these companies had market capitalization of over $1 billion. In addition, there were a further 947 exploration and mining companies listed on the TSX venture exchange. Approximately one third of the world's equity capital for exploration and mining was raised by TSX and TSX venture-listed companies.

Exploration Expenditures

Final exploration data for 2001 show that exploration and deposit appraisal expenditures amounted to $512.9 million, an increase of 3.3% over the $496.7 million in 2000. Final figures for 2002 show an increase of 11.8% to $573.4 million. Spending intentions for 2003 indicate a further 19.3% increase to $684.2 million.

In 2002, increases in exploration and deposit appraisal expenditures were experienced in most regions, with the exceptions of New Brunswick, the Yukon and the Northwest Territories. Ontario and Quebec were the only provinces with expenditures in excess of $100 million with $139.0 million and $111.2 million, respectively. The two provinces accounted for 43.6% of total Canadian expenditures.

The level of mineral exploration activity is closely linked to mineral commodity prices. As commodity prices are showing signs of renewed strength, the mineral exploration industry has responded with increased activity.

Capital Investment

Mine complex development expenditures (including capital expenditures for construction and machinery and equipment) were $2.1 billion in 2002, down 18.6% from 2001, due mainly to major projects in Quebec, Ontario and the Northwest Territories reaching completion. The Northwest Territories at 25.2%, Ontario at 21.5% and Quebec at 18.9% were the three leading jurisdictions for mine complex development expenditures. Company intentions reported for 2003 indicate a further decline to $1.9 billion.

According to Statistics Canada, preliminary actual expenditures in 2002 for capital for construction, materials and equipment in the mining and mineral processing industries decreased sharply by 22.2% to $4.5 billion. Revised intentions for 2003 indicate a strong rebound to $5.4 billion.

For the total Canadian economy in 2002, capital investment (construction, materials and equipment) reached $204.3 billion, an increase of 2.0% over the $200.3 billion expected in 2001. Revised estimates for 2003 show a further increase to $212.5 billion.

Technology Investment

Preliminary estimates for 2002 show that total intramural research and development expenditures by the mining industry reached $46 million, the same as in 2001. These levels are lower than the revised figure of $52 million in 2000. Intentions for expenditures in 2003 are estimated to rise to $49 million.

HIGHLIGHTS IN THE CANADIAN MINING INDUSTRY

Corporate Developments

Corporate operating profits in the Canadian mining industry were $1.6 billion in 2002, compared to $2.3 billion in 2001 and $3.1 billion in 2000. Capacity utilization for mining stood at 81.1% for the last quarter of 2002 compared to 80.6% for the first quarter of the same year. Over the same period, the capacity utilization rate for primary metals went from 89.4 to 93.7%.

In February, De Beers Canada Mining submitted an environmental assessment report for its Snap Lake underground diamond mine, located approximately 220 km northeast of Yellowknife, Northwest Territories. On the basis of receiving all necessary approvals and permits by the third quarter of 2003, the company estimates that construction of Canada's third diamond mine could begin in 2004, which could mean a start-up in late 2005 and full production by 2006. The proposed mine is expected to produce 1.5 million carats annually over a 22-year life at a daily production rate of 3000 t. The projected capital cost is US$320 million.

In February, Teck Cominco Limited, Indian and Northern Affairs Canada and the Yukon government announced the termination of their Memorandum of Understanding (MOU) on the management of assets at the inactive Faro lead and zinc mine in the Yukon. In August 1999, the three parties had entered into an MOU to keep the assets of the mine site intact in anticipation of the re-opening of the Faro operation should metal prices improve. Because higher prices failed to materialize, the arrangement was terminated. The interim receivership of the Faro property is still the subject of court proceedings in Ontario. The previous owner of the mine, Anvil Range Mining Corporation, closed the mine and went into receivership in early 1998.

In March, Boliden AB announced that it was resuming production at its underground zinc-copper mine at Myra Falls, British Columbia, which has been closed since December 2001. The decision was made after an agreement was reached with employees, unions, suppliers and customers regarding an extensive action plan. The plan contains measures aimed at improving the operating efficiency of the mine and includes a reduction of the work force by approximately 17%. Myra Falls has been in production for 36 years and has been owned by Boliden since 1998.

In March, Noranda Inc. announced that it would permanently close its Gaspé copper smelter located in Murdochville, Quebec, effective April 30, 2002. In November 2001, the company had announced its intentions to temporarily close the smelter for at least six months in response to weak market and economic conditions. However, following a comprehensive study, Noranda concluded that there was no economically feasible solution to continue operating the smelter. The smelter, which began operations in 1955, became a custom copper smelter in late 1999. Since then, the smelter treated purchased copper concentrate from around the world, along with secondary copper materials, and employed, on average, 300 workers.

On April 1, North American Tungsten Corporation Limited began commercial production from its CanTung tungsten mine following a nine-month development and pre-production time period. Annual production is expected to be 350 000 MTUs (1 metric tonne unit equals 10 kg) of high-grade tungsten concentrates based on a mill throughput design of 870 t per day. The mining operation is located in the Northwest Territories near the Yukon border, north of Watson Lake, Yukon.

In April, SIAMtec, a limited partnership company, was formed by Noranda Inc. (75%) and STAS (25%) to market and distribute Noranda's mining automation technologies. STAS, a Canadian company that specializes in marketing high-tech equipment, has been involved with Noranda since 1995 to support the implementation of Noranda's technologies. Since 1988 when Noranda began developing mining automation technologies, these technologies have been successfully implemented at nine different mining operations in four countries, including Noranda mines.

For Voisey's Bay developments, please refer to the Nickel chapter in this edition of the *Canadian Minerals Yearbook.*

In October, the Sherritt Coal Partnerhip II made a takeover bid for all the shares of Fording Inc. In response, Fording initiated action to convert itself into a coal income trust and then proposed to combine with Teck Cominco Limited and the Westshore Terminals Income Fund to become a multi-party coal trust. Following several counterbids, the parties on both sides came together in early January 2003 to form the Fording Trust Partnership. Teck Cominco will own 35% (this could increase an additional 5% if certain operational and marketing objectives are met by March 31, 2007) with the remaining 65% to be owned by the Fording Canadian Coal Trust. The Partnership will combine the metallurgical coal assets of Fording, Teck Cominco, the Luscar Energy Partnership and CONSOL Energy Inc. These include Teck Cominco's Elkview mine, Fording's Greenhills and Fording River mines, Luscar/CONSOL's Line Creek mine in southeastern British Columbia (Elk River Valley), Luscar/CONSOL's Luscar mine, their undeveloped Cheviot property in southwestern Alberta, and their 46.4% interest in Neptune Bulk Terminals (Canada) Ltd. located in North Vancouver, British Columbia. The Partnership will negotiate a long-term port contract with Westshore Terminals' port facility at Roberts Bank, British Columbia, based on commercial terms previously negotiated between Fording Inc. and Westshore. In a related separate transaction, Fording is selling its prairie thermal coal operations and assets, subject to a royalty on production from certain coal properties, to the Sherritt Coal Partnership II for $225 million.

The Fording Canadian Coal Trust will be owned 38.6% by Fording shareholders, 22.7% by the Sherritt Coal Partnership II (a partnership of Sherritt International Corporation and the Ontario Teachers Pension Plan Board), 9.1% by Teck Cominco Ltd., 9.1% by Westshore Terminals Income Fund, 7.7% by the Ontario Teachers' Pension Plan, 6.8% by the Luscar Energy Partnership, and 6.8% by CONSOL Energy Inc. The Fording Trust Partnership will be operated by Teck Cominco and managed by Fording, and will rank as the second-largest metallurgical coal company in the world, supplying about 20% of the seaborne high-quality metallurgical coal market (about 25 Mt/y). Shareholders approved the complex transaction in February 2003.

In November, Noranda Inc. provided a progress report on the Magnola magnesium plant at Danville, Quebec. Magnola is owned 80% by Noranda and 20% by La Société générale de financement du Québec (SGF). In March 2003, Métallurgie Magnola Inc. announced that it would be idling the plant. The shut-down took place in mid-April and is for an indefinite period until improved magnesium prices enable the viable operation of the plant. Approximately 380 people were employed at the plant. It is estimated that Noranda and SGF have jointly invested $1.3 billion in the construction and start-up of Magnola since 1997.

In December, Cameco Corporation (which already owns 15.0% of Bruce Power), TransCanada PipeLines Limited and BPC Generation Infrastructure Trust, a trust established by the Ontario Municipal Employees Retirement System (OMERS), agreed to purchase 79.8% of Bruce Power Limited Partnership (Bruce Power) from British Energy plc, which currently holds an 82.4% interest. The Power Workers' Union and The Society of Energy Professionals will obtain the remaining 2.6%. Bruce Power operates the Bruce nuclear electricity-generating complex near Kincardine, Ontario. The purchase price under the agreement is estimated to be about $950 million, of which $770 million ($630 million in cash when the deal closes) goes to British Energy, $100 million to the Government of Ontario, and $220 million to cover certain liabilities. In addition, the consortium of Cameco, TransCanada and OMERS will acquire the 50% interest that Bruce Power holds in Huron Wind, Ontario's first commercial wind farm. As a result of the agreement, Cameco purchases an additional 16.6% interest in Bruce Power, bringing its total interest to 31.6%. TransCanada and BPC will each acquire a 31.6% interest in Bruce Power, and the unions, who currently own a 2.6% interest, will obtain an additional 2.6% at closing to bring their total ownership to 5.2%. Cameco's uranium fuel supply management responsibility to Bruce Power remains.

In December, Noranda Inc. announced that it was planning to operate its Brunswick lead smelter at Belledune, New Brunswick, on an eight-month seasonal basis, shutting down for four consecutive months each year beginning in July 2003. Citing low treatment charges and a weak forecast for the lead market, Noranda expects to produce about 78 000 t of lead and 5 million oz of silver on this annual operating schedule. As well, beginning in 2003, the Brunswick smelter will withdraw from custom smelting. During the four-month shut-down period, staff and hourly employees will be laid off except for a minimum number required to keep the plant on care and maintenance. Approximately 470 people are currently employed at the smelter.

The Diavik diamond mine at Lac de Gras in the Northwest Territories continued with advanced development in 2002 towards its projected start of diamond production in January 2003. The project is located on a 20-km^2 island in Lac de Gras approximately 300 km from Yellowknife. Four kimberlite pipes will be mined over an estimated 20-year life using a work force of approximately 450. The project is an unincorporated joint venture between Diavik Diamond Mines Inc. (DDMI) (60%) and Aber Diamond Mines Ltd. (40%); DDMI is the operator. DDMI is a wholly owned subsidiary of Rio Tinto plc and Aber is a wholly owned subsidiary of Aber Diamond Corporation. Late in the year, overburden removal from the A-154 open pit was actively under way, as were commissioning trials of the processing and recovery plants. In December, recovered diamonds were sent to Diavik's production splitting facility in nearby Yellowknife for cleaning and preparation for valuation for royalty purposes. Total project expenditures to the end of 2002 were estimated to be $1.22 billion with the expected total cost to be $1.25 billion following completion.

Tiffany and Co. announced in October that it would open a diamond-cutting and polishing facility in Yellowknife to process its share of diamonds from the Diavik mine. Tiffany owns 14.7% of Aber and has an agreement with Aber to sell US$50 million worth of diamonds annually over a 10-year period.

Other important events in 2002 included:

- Miramar Mining Corporation and Hope Bay Gold Corporation combining their assets, with the resulting company, Miramar, having a 100% interest in the Hope Bay gold project in Nunavut, located some 865 km north of Yellowknife and 170 km southwest of Cambridge Bay;
- Kinross Gold Corporation, TVX Gold Inc., and Echo Bay Mines Ltd. agreeing to merge their three companies, making the new Kinross the world's seventh largest primary gold producer (the deal officially closed in February 2003);
- Employees at Noranda's Horne copper smelter at Rouyn-Noranda going on strike in June (at year-end the strike was still ongoing with the facility operating at more than 70% of capacity with management and non-union personnel); and
- Dofasco Inc. and Companhai Auxiliar de Empresas de Mineracao (CAEMI) of Brazil announcing that they were reducing their co-ownership of Quebec Cartier Mining Company (QCM) (Dofasco indicated that its current iron supply contract with QCM would remain in place).

Government Initiatives

The Government of Canada, the provincial and territorial governments, the mineral industry and others undertook a number of activities to promote and support Canada's minerals and metals industry and mining-related equipment and services sectors in 2002.

At the federal level, specific activities in 2002 to promote Canada's trade, carried out by Natural Resources Canada, included participation/support at the following events: the

Prospectors and Developers Association of Canada's annual convention held March 9-13 in Toronto; the Indaba-Investing in African Mining Conference held February 11-14 in Cape Town, South Africa; the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Tradex held April 28-May 1 in Vancouver; EXPOMIN held May 4-11 in Santiago (Chile); an E-commerce workshop held May 24 in Sudbury; ELECTRA-MINING held September 30-October 4 in Johannesburg, South Africa; Naturallia, held October 28-31 in Rouyn-Noranda; and the ministerial mission to India held from November 10 to 16.

Table 3 summarizes some of the major initiatives undertaken by the federal, provincial and territorial governments in support of the Canadian mining industry.

PROFILES OF THE LEADING MINERALS PRODUCED IN CANADA

Gold

Canada has a long history of being one of the world's leading producers of gold. In 2002, Canada was the seventh largest global gold producer, trailing South Africa, the United States, Australia, China, Russia and Peru. Canada-based Barrick Inc. and Placer Dome Inc. are two of the top global gold-producing companies. In 2002, gold mining was carried out in all provinces and territories with the exception of Nova Scotia and Prince Edward Island. Gold refineries are located in Quebec and Ontario. The main use for gold is in jewellery manufacturing, with other important uses including electronics, dentistry and coinage. Gold bullion is also important as a global investment-demand product.

In 2002, gold was Canada's leading metallic mineral as the value of gold production increased by 7.4% to $2.3 billion. The volume of shipments, however, decreased by 6.9% to 147 866.2 kg. In December, the Government of Canada sold 83 399 oz of gold, reducing its gold reserves to about 599 000 oz. When the government began gold sales in the early 1980s, official gold reserves stood at about 21 million oz.

Copper

In global terms in 2002, Canada was ranked as the seventh leading producer of copper following Chile, Indonesia, the United States, Australia, Peru and Russia. Canada-based Noranda Inc., Hudson Bay Mining and Smelting Co. Limited and Inco Limited are major world producers of copper. Copper is mined in New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan and British Columbia with primary smelters located in Quebec, Ontario and Manitoba and refineries located in Quebec, Ontario and British Columbia. Copper's properties, especially its high electrical and thermal conductivity, good tensile strength, relatively high melting point and resistance to corrosion, make it and its alloys attractive for electrical transmission, water tubing, castings and heat exchangers.

In 2002, the value of copper production in Canada decreased by 7.6% to $1.4 billion, with production down by 6.1% to 577 032.5 kg. In value terms, copper was Canada's third leading metal in 2002.

Zinc

Canada was the world's fourth largest producer of zinc in 2002, trailing China, Australia and Peru, and ahead of the United States. Canada-based Teck Cominco Ltd. and Noranda Inc. are two of the largest zinc producers in the world. In 2002, zinc was mined in New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, British Columbia and Nunavut, with metallurgical plants located in Quebec, Ontario, Manitoba and British Columbia. The main uses of zinc are as a coating (galvanizing) for steel to protect it from corrosion and in the manufacture of brass and bronze and die-casting.

In 2002, the value of zinc production decreased by 23.6% to $1.1 billion as production fell by 11.9% to 891 924.2 kg. Zinc was Canada's fifth leading metal based on value of production.

Nickel

Canada is the world's third leading nickel producer behind Russia and Australia. In 2002, the next leading producers were Indonesia and New Caledonia. Globally, the industry is relatively small and is dominated by several large producers, including Canada-based Inco Limited and Falconbridge Ltd. In 2002, nickel was mined in the provinces of Ontario, Manitoba and Quebec with smelters in Ontario and Manitoba and refineries in Ontario and Alberta. Nickel's resistance to corrosion, high strength, pleasing appearance and suitability make it useful in many applications. Major markets include stainless steels (which use about 65% of nickel production), nickel and copper-based alloys, electroplating, alloy steels, and foundry products.

In 2002, the value of Canadian nickel production rose by 6.0% to $1.9 billion, even though production of 178 338.1 kg represented a decline of 3.2% over 2001. Based on its value of production, nickel was Canada's second leading metal in 2002.

Iron Ore

Canada is a major producer of iron ore with North American steel producers being the major users of Canadian-mined iron ore. In global terms, Canada ranked ninth in production in 2002 behind Brazil, Australia, China, India, Russia, Ukraine, the United States and South Africa. The major Canadian-based producers of iron ore are the Iron Ore Company of Canada, Quebec Cartier Mining Company, and Wabush Mines. Production takes place in Newfoundland and Labrador, Quebec and British Columbia. Iron ore is upgraded in Canada for steelmaking use as pellets and concentrates.

In 2002, the value of Canadian production rose by 17.1% to $1.4 billion with production increasing by 14.2% to 31 Mt. Iron ore was Canada's fourth leading metallic mineral in terms of value in 2002.

Uranium

Canada is the world's largest producer and exporter of uranium, typically delivering over 85% of annual production to trading partners around the world. In 2002, Canada accounted for over 30% of global uranium production, followed by Australia, Niger, Namibia and Russia. All Canadian uranium production takes place in Saskatchewan and Saskatoon-based Cameco Corporation is the world's largest producer. Cameco also operates Canada's only refinery and conversion facilities in Ontario and is a partner in the Bruce nuclear power plant, also in Ontario. Canadian uranium is used exclusively as fuel for generating electricity in nuclear power plants, although a very small amount may be used to produce isotopes for applications in nuclear medicine.

Canadian uranium mines and mills set high standards for workplace safety and environmental management. Cluff Lake won awards for being Canada's safest metal mine in 1998 and 2002. Environmental management systems at the McArthur River mine and the Key Lake mill were certified under the ISO 14001 standard in 2003. The McClean Lake mine and mill, as well as the Blind River refinery and Port Hope conversion plant, have already achieved this internationally recognized standard, which outlines key requirements with which companies should comply in order to operate in an environmentally responsible manner.

In 2002, the value of shipments from mines in Canada increased by 0.5% to $608.4 million with production also up by 0.5% to 13 055.9 tU.

Potash

Potash refers to a group of potassium-bearing minerals and chemicals. The dominant potash product is potassium chloride, a naturally occurring pink, salty mineral for which Canada is the world's leading producer and exporter. Internationally in 2002, Russia, Belarus and Germany were the other leading producers. In Canada, potash was produced in Saskatchewan and New Brunswick, with the Potash Corporation of Saskatchewan Inc. being the largest potash producer and exporter in the world. Fertilizer use consumes over 90% of the output. Other uses include detergents, ceramics, chemicals and pharmaceuticals.

The value of Canadian production fell by 1.2% in 2002 to $1.6 billion as production decreased by 0.6% to 8188.7 t. Potash was Canada's leading nonmetallic mineral in 2002.

Diamonds

Canada became a diamond producer in 1998 with the start-up of the Ekati mine, now owned 80% by BHP Billiton Plc, in the Northwest Territories. Diamond-cutting and polishing facilities are now operating in Canada, processing a portion of Canadian production. Besides jewellery manufacturing, tools and equipment manufacturing are important markets for diamonds. On a global scale, it is estimated that in 2001 Canada ranked fifth in terms of the value of diamond production. This ranking will increase with the start-up of the Diavik mine in 2003 and the Snap Lake project, possibly in full production as early as 2006, both located in the Northwest Territories.

In 2002, the value of diamond production in Canada increased by 11.7% to $801.5 million as production rose by 34.1% to 4 984 000 ct.

Aluminum

Canada has been a leading producer of aluminum for some three quarters of a century with smelter production based on hydro-electric power. Aluminum is produced in two provinces, Quebec (90%) and British Columbia (10%), from imported alumina, alumina extracted from imported bauxite, and recycled materials. Because of its light and rust-resistant properties, it is used extensively in transportation, packaging, and building and construction applications. Globally, Canada was the third leading producer of primary aluminum in 2002, trailing China and Russia and ahead of the United States. The largest Canadian company, Alcan Aluminium Inc., is the world's second largest producer.

In 2002, production of Canadian primary aluminum increased 4.9% to 2.71 Mt, compared with 2.58 Mt in 2001. The value of this production, at $5.7 billion, however, was down slightly from $5.8 billion in 2001.

Because aluminum in Canada is initially produced entirely from imported materials, its value is not reflected in the mineral production statistics that appear elsewhere in this chapter. However, its value is reflected in the GDP of the mineral industry, where its production and processing are major components of Stages 2 and 3.

OUTLOOK AND TRENDS FOR THE CANADIAN MINERALS AND METALS INDUSTRY

The outlook for economic activity around the world at the beginning of 2003 was clouded by many factors, including geopolitical tensions, principally those involving Iraq and North Korea and the global war on terrorism, international trade disputes, and under-performing economies around the world. As well, energy prices shot up in late 2002 and into 2003 over supply concerns and a cold winter in North America. All of these factors had a dampening effect on consumer spending and business activity in early 2003, bringing uncertainties to commodity markets. Consequently, with the exception of some mineral commodities such as gold, which is viewed by many as a haven for investment in times of trouble, and nickel, which has experienced increasing demand in China and Asia, most global commodity activity will likely remain sluggish and lacklustre, at least for the first part of 2003. As we move through 2003, however, the economic picture is brighter, particularly with respect to the United States.

With the slowing of the Canadian economy in the last quarter of 2002 and a decline in the second quarter of 2003 brought about mainly by rapid appreciation of the Canadian dollar vis-à-vis the U.S. dollar and by fallout from the SARS outbreak, most economists are forecasting that real GDP growth for 2003 will be about 2%, compared to the 3.3% growth rate experienced in 2002. Capital investment is expected to slowly recover. Low mortgage rates have contributed to a strong housing market and inflation rates are expected to remain well within the Bank of Canada's target range of 1-3%. Because over 85% of Canada's exports are destined for the United States, the Canadian economy will benefit from stronger U.S. economic growth. However, the appreciation of the Canadian dollar will limit the boost that the Canadian economy receives. While importers and consumers will benefit from the stronger dollar, the negative impact on exporters will likely be the dominant effect.

Globally, forecasters were looking at about a 3.0% rate of growth in 2003, the same as in 2002 and up from the 2.3% growth experienced in 2001. The United States is forecast to grow at about 2.7% in 2003, up from 2.4% in 2002. The European Union is expected to experience growth of only about 0.6% in 2003, compared to 0.9% in 2002; China, at 8.1%, is up slightly from 8.0% in 2002, and South Korea, at 2.0% growth, is down from 2.3% in 2002. Japan, with the Bank of Japan supporting the Japanese export sector, will see its growth rate approach 2.0% in 2003, up from the 0.2% rate experienced in 2002.

In order to reduce commodity cash costs, mining companies will continue to strive to make their operations more efficient, particularly for the major metals. As well, companies will continue to seek out consolidations, mergers and acquisitions, particularly where mining and processing assets can be obtained at prices cheaper than greenfield developments. Although for many commodities the demand/supply dynamics were better in 2002 than in 2001, this did not necessarily translate into higher prices or better financial results. This is also likely to continue to be the case in 2003, although gold and nickel producers, who benefited from higher prices in 2002, are likely to continue to do the same in 2003.

Importantly, in 2003, the health of the global minerals and metals industry will be very much subject to the geopolitical factors at play and the rate of recovery of capital investment spending, and on their collective impact on the demand for mineral commodities. If global uncertainties are protracted, significant negative impacts may be expected on the operating and financial performance of most mining companies, including Canadian companies, in 2003.

The Canadian mining industry experienced decreased operating profits for the second year in a row in 2002 and this trend is not expected to change in 2003. Although the industry is faced with the many uncertainties existing in the current global marketplace, it is well positioned to benefit from a meaningful upturn in global economic activity, particularly in the United States. The strong gold prices of late 2002 and 2003 should benefit many Canadian companies and strengthen exploration activity in Canada. Exploration activity is also positively driven by the continuing exploration interest for diamonds in many parts of Canada. With the exception of diamonds and nickel developments, the dearth of significant new mine development is becoming more and more of a concern for the Canadian industry.

Notes: (1) Information in this review was current as of August, 2003. However, the statistics presented in this review are subject to revision as more recent data become available. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002CMY_e. htm.

NOTE TO READERS

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TABLE 1. CANADA, PRODUCTION OF LEADING MINERALS, 2001 AND 2002$^{(p)}$

		Volume		Percent Change	Value		Percent Change
		2001 (r)	2002 (p)	2002/2001	2001 (r)	2002 (p)	2002/2001
		(000 tonnes except where noted)			($ millions)		
METALS							
Gold	kg	158 875	147 866	-6.9	2 135.3	2 292.4	7.4
Nickel		184	178	-3.2	1 777.4	1 883.3	6.0
Copper		614	577	-6.1	1 535.2	1 418.9	-7.6
Iron ore		27 119	30 969	14.2	1 188.9	1 391.7	17.1
Zinc		1 012	892	-11.9	1 426.0	1 089.9	-23.6
Uranium	tU	12 991	13 056	0.5	605.4	608.4	0.5
Platinum group	kg	20 694	21 829	5.5	651.9	449.5	-31.0
Silver	t	1 265	1 344	6.2	277.9	314.5	13.2
Lead		150	99	-34.1	109.5	70.7	-35.4
Cobalt	t	2 112	2 027	-4.0	81.0	49.0	-39.5
Molybdenum	t	8 556	7 521	-12.1	73.8	x	x
NONMETALS							
Potash (K_2O)		8 237	8 189	-0.6	1 617.4	1 597.8	-1.2
Cement		12 986	13 201	1.7	1 348.3	1 387.5	2.9
Sand and gravel		236 486	229 535	-2.9	1 062.2	1 047.4	-1.4
Stone		124 758	119 113	-4.5	957.0	971.8	1.5
Diamonds	000 carats	3 716	4 984	34.1	717.8	801.5	11.7
Salt		13 725	12 313	-10.3	426.1	412.1	-3.3
Clay products		. .	. .	. .	194.6	235.2	20.9
Lime		2 213	2 237	1.1	213.8	220.5	3.1
Peat		1 319	1 301	-1.4	186.4	190.1	2.0
Gypsum		7 821	8 847	13.1	96.0	112.7	17.5
Asbestos		277	241	-13.0	118.7	98.0	-17.5
Nepheline syenite		710	724	2.0	65.5	67.9	3.6
Sulphur, in smelter gas		762	751	-1.4	33.8	46.1	36.6
Quartz (silica)		1 613	1 556	-3.5	44.7	43.5	-2.7
Soapstone, talc, pyrophyllite		45	84	86.7	15.2	22.9	50.6
Sulphur, elemental		8 154	7 787	-4.5	1.3	0.6	-55.9
MINERAL FUELS							
Petroleum, crude	million m^3	129 810	137 357	5.8	25 181.4	30 794.5	22.3
Natural gas	000 m^3	171 388	171 348	0.0	33 677.5	23 295.9	-30.8
Natural gas by-products	000 m^3	29 321	29 542	0.8	4 575.3	3 290.8	-28.1
Coal		70 355	66 822	-5.0	1 557.1	1 593.1	2.3

Sources: Natural Resources Canada; Statistics Canada, *Canada's Mineral Production, Preliminary Estimates*, 2002, cat. no. 26-202-XIB.
. . Not available; (p) Preliminary; (r) Revised; (x) Confidential.
Notes: Numbers have been rounded. Percent changes are based on unrounded data.

TABLE 2. CANADA, VALUE OF DOMESTIC EXPORTS, TOTAL EXPORTS (INCLUDING RE-EXPORTS), IMPORTS AND BALANCE OF TRADE OF MINERALS AND MINERAL PRODUCTS, STAGES 1-4 (CUSTOMS BASIS), 1998-2002

	1998	1999	2000	2001	2002
			($000)		
TOTAL MINING, INCLUDING FUELS					
Domestic exports	68 382 980	71 861 697	99 760 591	100 310 690	96 899 664
Total exports	69 521 529	73 031 974	101 236 450	102 054 663	99 158 777
Imports	53 916 392	55 518 576	69 589 621	64 335 122	65 138 193
Balance of trade	15 605 137	17 513 398	31 646 829	37 719 541	34 020 584
NON-FUEL MINING					
Domestic exports	42 810 678	42 643 840	47 644 303	45 456 092	47 749 445
Total exports	43 799 352	43 671 966	48 954 359	46 785 117	49 106 962
Imports	43 104 885	43 950 354	50 206 433	45 487 105	47 220 295
Balance of trade	694 467	-278 388	-1 252 074	1 298 012	1 886 667
TOTAL NON-FUEL MINING, INCLUDING COAL					
Domestic exports	45 333 220	44 688 176	49 516 976	47 441 179	49 591 273
Total exports	46 322 890	45 719 792	50 829 143	48 770 709	50 967 018
Imports	44 246 412	45 067 034	51 370 424	46 750 352	48 518 567
Balance of trade	2 076 478	652 758	-541 281	2 020 357	2 448 451
TOTAL ECONOMY					
Domestic exports	297 509 218	331 748 264	385 658 811	375 116 189	365 139 657
Total exports	318 444 012	355 420 305	413 195 348	403 971 726	396 298 300
Imports	298 386 345	320 408 693	356 862 357	343 075 981	348 444 586
Balance of trade	20 057 667	35 011 612	56 332 991	60 895 745	47 853 714

Sources: Natural Resources Canada; Statistics Canada.

TABLE 3. MAJOR GOVERNMENT INITIATIVES IN SUPPORT OF THE CANADIAN MINING INDUSTRY

Date	Jurisdiction	Legislation/Acts	Projects	New/Renewal/Update	Budget/Cost	Description	Additional Notes/ Web Sites
March 2002	Newfoundland and Labrador		Hope Brook reclamation		$10 million	The Hope Brook gold mine closed in 1997 and receivership and ownership of site was transferred to the provincial government in December 1999.	
April 2002	Yukon	Mineral Exploration Tax Credit (METC)		Extension to April 2003		Bill 55, *An Act to Amend the Income Tax Act*, tax credit of up to 25% on eligible expenditures.	www.btc.gov.yk.ca/ marketing/investyukon/ pdf/mining.pdf
April 2002	Nunavut and Government of Canada		Canada-Nunavut Geoscience Agreement	Renewal for five more years until March 31, 2008		The co-managed Canada-Nunavut Geoscience Office wil continue to collect and make accessible geoscience information and expertise in Nunavut to support sustainable development, geoscience capacity building, education and training, and awareness and outreach activities. Coordinated approach between NRCan, the Nunavut Department of Sustainable Development, and the Department of Indian Affairs and Northern Development for geoscience activities in Nunavut.	
May 2002	Manitoba	Manitoba Mineral Exploration Tax Credit (MMETC)		New		MMETC is a non-refundable 10% personal income tax credit for resident investors in eligible flow-through shares of qualifying mineral exploration companies. No cap on maximum eligible investment by an individual investor and no limit on the maximum amount of the tax credit. MMETC will parallel and top up the 15% federal exploration flow-through share tax credit. Resident of Manitoba, all exploration activity must be undertaken in Manitoba.	www.gov.mb.ca/itm/mrd/ busdev/incentives/ mmetc.html
May 2002	Manitoba	Mineral Exploration Assistance Program (MEAP)		Renewal for three more years until March 31, 2005	$2.5 million per year	MEAP provides financial assistance for non-fuel mineral exploration in Manitoba. Offerings correspond to spring/summer and fall/winter mineral exploration phases. Program provides assistance of up to 25% for approved eligible expenditures to a maximum of $300 000 per recipient per fiscal year. Two-tier percentage of offering approach, up to 35% of approved eligible expenditures to a maximum of $400 000 per recipient per fiscal year is available.	www.gov.mb.ca/itm/mrd/ busdev/incentives/meap-off.html
May 2002	Manitoba	Manitoba Prospectors Assistance Program (MPAP)		Renewal for three more years until March 31, 2005	$125 000 per year	To encourage mineral prospecting in the province with funding available on a spring/summer and fall/winter basis. To prospectors exploring on either their own properties or open Crown mineral land. Receive up to $9000 per applicant per year.	www.gov.mb.ca/itm/mrd/ busdev/incentives/mpap-off.html
May 2002	Manitoba	*Mines and Minerals Act*		Proposed amendments		To streamline and clarify mining regulations governing the minerals industry in Manitoba and enhance the stability of land tenure, and to encourage more exploration by smaller companies and individual prospectors. Replaces both types of exploration permits with the new mineral exploration licence.	http://web2.gov.mb.ca/ laws/statutes/ccsm/ m162e.php
May 2002	CANMET, CERM3, UBC		Research office at Britannia Beach, B.C.	New		For research and development of environmental technologies, development and optimization of treatment and remediation processes through to refinement of methodologies for understanding the enviromental risks of mine wastes. R&D on phytoremediation.	http://srmwww.gov.bc.ca/ clrg/britannia/index.html
May 2002	Minerals and Metals Sector, Natural Resources Canada (NRCan)		Conceptual design study for the development of a world-class mining interpretive centre and heritage park at Britannia Beach, B.C.	New		Park theme is envisioned as "the legacy of the past - looking to the future" with the intent to showcase the history and "way of life" of Britannia Beach. Project planning involvement include the BC Mining Museum, CERM3 Research Park, and consideration of coastal First Nations people and cultures.	

TABLE 3. (cont'd)

Date	Jurisdiction	Legislation/Acts	Projects	New/Renewal/Update	Budget/Cost	Description	Additional Notes/ Web Sites
May 2002	British Columbia	Bill 54, the miscellaneous statutes amendment act (No. 2)		Amendments of *Mineral Tenure Act* and the *Mines Act*		Clarifying a titleholder's responsibilities when operating on private land allowing for the mediation and arbitration board to resolve conflicts and establish compensation when a titleholder proposes to explore on private land. Creation of a two-zone system that defines lands as either open or closed to mining. Allowing the chief gold commissioner to reinstate a mineral title that has expired.	www.legis.gov.bc.ca/ 37th3rd/3rd_read/ gov54-3.htm
May 2002	British Columbia	*Mines Act*		Amendments to *Mines Act*		Allowing the chief inspector of mines to authorize permit exemptions for low-level mining exploration activities if the proposed work meets regulation criteria. Creation of a more transparent exemption process and a shorter turnaround on authorizations for eligible mineral exploration sites. Exempting pits and quarries from the requirement for a *Mines Act* permit when associated with authorizations issued by another provincial agency.	
June 2002	British Columbia		First geoscience partnership agreement with mineral exploration company Eastfield Resources	New		Ability to combine their geological knowledge and expertise with logistical and financial support. To study the regional geology surrounding the company's Lorraine copper-gold deposit 300 kilometres northwest of Prince George. The partnership with Eastfield Resources will support the project and produce the information that the Ministry believes is necessary to attract other potential investors to the area. The Ministry was considering partnerships with other exploration companies and indicated that preferred projects would be those that benefit multiple clients and address regional aspects of geology, geochemistry, geophysics and mineral deposits.	www.news.gov.bc.ca/ #searchnews - enter keyword Eastfield Resources - highlight Ministry of Energy and Mines - Go
July 2002	NRCan and Canadian Economic Development for Quebec regions		Asbestos Institute (non-profit organization)	New	$500 000 for funding	The contribution assists with the implementation of the responsible use of chrysotile asbestos policy as described in the Memorandum of Understanding between the Government of Canada and Canadian asbestos producers signed on March 3, 1997.	www.nrcan.gc.ca/ media/newsreleases/ 2002/200286_e.htm
August 2002	British Columbia	*Environmental Assessment Act*	Higland Valley Copper mine, Kamloops	New		The mine was scheduled to close in mid-2005, but a project approved under the provincial *Environmental Assessment Act* to remove water from the mine to stabilize it will extend mine operations by another three and a half years until 2009.	www.eao.gov.bc.ca/epic/ output/documents/p152/ 1036005411961_7e4d91f a452e44b6a3cfce2ad 945f564.pdf
Sept. 2002	NRCan, FedNor, EDAC, provinces of Quebec and Ontario, Canadian Institute of Mining, Metallurgy and Petroleum		Naturalia International Forum		$50 000 (NRCan contribution)	The Forum brought together business decision-makers from around the world in Rouyn-Noranda, Quebec, from October 29 to 31, 2002, to help firms widen their markets and develop alliances for technology development. The initiative was dedicated to helping small- and medium-sized mining and forestry businesses establish partnerships and alliances. More than 200 firms from five continents attended to expand distribution networks, create alliances for technology development, and sell products, services, licences and patents.	www.nrcan.gc.ca/media/ newsreleases/2002/2002 108_e.htm
Sept. 2002	Saskatchewan	Mineral exploraiton incentive program (six years)		New	$2.1 million annually	The initiatives provide incentives for both prospector and exploration companies and provide enhanced geoscience funding.	www.gov.sk.ca/newsrel/ releases/2002/09/ 19-731.html
			Prospector Incentive Program	New	$100 000 annually	To encourage grass-roots mineral exploration in Saskatchewan. Qualified applicants can receive 50% of eligible costs to a maximum of $7500 per fiscal year upon approval. Program is limited to one approved project per year per qualified applicant.	
			Exploration Incentive Program	New	$1.1 million anually	For mineral exploration companies carrying out grass-roots exploration in Saskatchewan. Companies can receive 25% of the eligible exploration costs to a maximum of $100 000 per year. The Exploration Incentive Program is limited to one approved project per year per applicant.	

Sept. 2002	Saskatchewan		Enhanced Geoscience Program	Update	Additional $400 000 per year	Funding for airborne geophysical surveys to provide new information to industry and government. The regional multi-parameter airborne geophysical surveys will reduce exploration risk by increasing the knowledge base of the province's mineral resource potential.	www.gov.sk.ca/newsrel/releases/2002/09/19-731-attachment.html
			10-Year Royalty Holiday for New Gold and Base-Metal Mines	New		Each new mine developed in Saskatchewan that is regulated under this royalty system will pay no royalties for the first 10 years of operation.	www.gov.sk.ca/newsrel/releases/2002/09/19-731-attachment.html
			Competitive Diamond Royalty and Tax Structure	New		The Department of Industry and Resources will work with the diamond companies to develop a competitive royalty system for Saskatchewan. Diamond mining companies in Saskatchewan will not be subject to the Corporate Capital Tax Surcharge.	www.gov.sk.ca/newsrel/releases/2002/09/19-731-attachment.html
			Rebate for Tax applied to Fuel in Mineral Exploration and Remote Power Generation	New		Mining and mineral exploration companies will be able to operate more efficient exploration programs. Only British Columbia and Saskatchewan have been applying a tax to fuel used for off-road mineral exploration activities and power generation at remote mines.	www.gov.sk.ca/finance/revenue/ft/bulletins/ft11.pdf
September 2002	Manitoba, NRCan		59th Canadian Mines Ministers' Conference	Renew the Intergovernmental Geoscience Accord		The agreement defines the complementary roles and responsibilities of governments with respect to geoscience and ensures that governments in Canada continue to work together to give Canadians accurate geoscience information. The original Accord, signed in 1996, has facilitated numerous cooperative field projects and helped make possible the Canadian Geoscience Knowledge Network, which is making geoscience knowledge from all government geological survey agencies across Canada available through the Internet.	
November 2002	Ontario, Northern Heritage Fund Corporation		To help launch the Deep Mining Research Consortium	New	$3.5 million over a five-year period	An initiative to develop and improve technologies for mining at depths below the 2000-m level. Will be administered by the Canadian Mining Industry Research Organization, a not-for-profit organization formed by a group of mining companies to promote and manage collaborative research in the mining sector. Pilot projects are expected to focus on identifying economical methods of developing deeper orebodies in existing mines and prolonging their life.	www.ulern.on.ca/nobi/Harris_NOBI.pdf
December 2002	The Mining Association of Canada (MAC)	Kyoto Protocol				MAC stated that the Canadian metal mining industry had decreased its energy consumption by 21% and improved its energy intensity by 20% (energy per unit of metal concentrate) in the period 1990-2000. Metal mining decreased its total GHG emissions (both direct and indirect emissions) by 19% and improved overall GHG intensity by 18.5%. Nonferrous metal mining and refining increased its GHG emissions by 1.2%, but improved its GHG intensity by 20%.	
December 2002	Government of Canada, NRCan	Bill C-14, Kimberley Process Certification Scheme (December 12, 2002)		New		Canadian certificates must accompany diamond exports from Canada beginning January 1, 2003. Natural Resources Canada will be responsible for ensuring that Canada meets its inspection and enforcement obligations under the international certification scheme. Under the scheme, the participating countries must, among other things, export rough diamonds in tamper-resistant containers and provide a certificate, validated by the government of the exporting country, confirming that the diamonds are conflict free.	http://mmsd1.mms.nrcan.gc.ca/kimberleyprocess/note_e.asp

Source: Provincial and territorial government web sites.

Canadian Reserves of Selected Major Metals, and Recent Production Decisions

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RESERVES OF SELECTED MAJOR METALS

In 2001, Canadian reserves of copper, nickel, lead, zinc, molybdenum, silver and gold decreased because only one small new mine came into production while four producing mines were closed and the amount of new ore discovered at existing mining operations was insufficient to replace the quantity of ore that was mined during the year (Table 1). This continued a trend of declining ore reserves that began in the early 1980s for base metals and in the late 1980s for gold.

The Voisey's Bay nickel-copper-cobalt deposit in Labrador is not included in Canadian reserves at the end of 2001, but a production decision was made in June 2002, resulting in an increase of 524 000 t in the reserves of copper and an increase of 893 000 t in the reserves of nickel.

Reserves Policy

Canadian reserves are estimated from information contained in annual and other corporate reports, and from the responses of mining companies to the annual Federal-Provincial/Territorial Survey of Mines and Concentrators.

Reserves reported here include only metal contained in material that is classified by companies as "proven" or "probable" (or their equivalents) at producing mines and in deposits that are firmly committed to production (Table 2). Metal contained in mineral resources classified by companies as "possible" (or its equivalents) is not included in national totals, nor is metal contained in deposits that have not advanced beyond the deposit appraisal phase (Figure 1). When available, only metal contained in mineable ore is included in Canadian totals to exclude losses inherent in the mining process. Every effort is made to achieve, from year to year, consistency in the reserves reported here; however, consistency ultimately depends on industry practice, which has evolved over the years. Imperial units reported by companies have been converted to metric units and the results have been rounded to the appropriate number of significant digits.

Reserves by Commodity

Gold

There were 1070 t of gold contained in Canadian mine reserves in December 2001. This represents a decrease of 6% (72 t) compared to December 2000. The major components of this decrease were deletions due to continuing low gold prices, together with the depletion of reserves without replacement at most of the gold mines in Canada. The only notable increases in gold reserves were reported at the Red Lake mine (+22 t) and the Williams mine (+13 t) in Ontario.

Silver

There were 12 593 t of silver contained in Canadian mine reserves in December 2001. This represents a decrease of 9% (1326 t) compared to December 2000. None of the silver-producing mines reported significant increases in their reserves during 2001.

Zinc

During 2001, Canadian reserves of zinc declined by about 1.1 Mt (12%) to a year-end total of approximately 7.8 Mt. The Sullivan mine in British Columbia and the Ruttan mine in Manitoba closed permanently and reserves decreased at most of the zinc producers. The only zinc mines to report an increase in ore reserves during 2001 were the 777 mine in Manitoba (46 000 t), the Myra Falls mine in British Columbia (76 000 t), and the Bell Allard mine in Quebec (244 000 t).

Lead

Canadian reserves of lead decreased by approximately 26% during 2001 to 970 000 t. The Sullivan mine in British Columbia closed after 92 years of production. The Brunswick No. 12 mine in New Brunswick has reserves

Figure 1

Generalized Model of the Mineral Resource Development and Mining Process

PHASE	MINERAL RESOURCE ASSESSMENT	MINERAL EXPLORATION					MINERAL DEPOSIT APPRAISAL				MINE COMPLEX DEVELOPMENT	MINE PRODUCTION	ENVIRON-MENTAL RESTORATION
		GRASS-ROOTS EXPLORATION											
	MRA	EX-1	EX-2	EX-3	EX-4	EX-5	DA-1	DA-2	DA-3	DA-4	MCD	MP	ER
STAGE	Various surveys, research and synthesis	Exploration planning	Regional reconnaissance and surveys	Prospecting and ground surveys of anomalies	Verification of anomalies and showings	Discovery and delimitation of a mineral deposit	Mineral deposit definition	Project engineering	Project economics	Feasibility study, production decision	Mine development, construction of processing plant and infrastructure	Production, marketing and renewal of reserves	Mine complex closure and decommissioning, site restoration
OBJECTIVES	Supply information and tools required to develop the mineral potential of the nation for economic benefit, in the perspective of sustainable development	Select target commodities. Establish exploration objectives and strategies. Select target areas and sites. Acquire claims or permits if appropriate	Seek anomalies of interest over wide areas by various survey methods. Select the more promising targets. Acquire claims or permits	Confirm the presence, exact location and characteristics of anomalies. Acquire claims, leases and properties	Investigate the cause of anomalies. Find mineral showings. Acquire additional claims, leases and properties	Discover, delimit and interpret grade, quality and tonnage of a new mineral deposit. Determine if it constitutes a mineral resource of "potential economic interest" to justify more intensive and detailed work	Define the limits, controls and internal distribution of grades, mineralogy and mineral processing characteristics of the deposit. Acquire all data required for project engineering and cost estimation	Determine, in an iterative fashion, the design, plans, schedules, capital cost and operating cost estimates for all aspects of the project. Establish technical feasibility and costs thoroughly and realistically	Obtain all the information required and determine, based on corporate objectives parameters for the economic, financial and social-political evaluation of the project.	Diligently validate and integrate project data, interpretations, estimations, plans and evaluations to achieve MCD and production objectives. Decide on whether to undertake the mining project. Obtain permits and financing.	Complete mine development and construction on schedule and within budgets and specifications. Ensure efficient and timely mine complex start-up according to schedule, specifications and cash flow forecasts.	Achieve commercial production on schedule and meet cash flow forecasts and quantity and quality specifications. Achieve mine profitability and company survival in the perspective of sustain-able development	Restore mine site, outside plant and infrastructure to environmentally acceptable condition. Ensure the future quality of the environment
EVALUATION METHODS	Geoscientific, mineral and economic surveys, research, compilations and synthesis by governments, research institutes, universities and industry	Metal and mineral market research. Review of geological and ore deposit information and of the legal, fiscal and socio-political context in various areas	Remote sensing, aerial photography and airborne geophysics. Prospecting, geology and geochemistry. Appraisal, rating and selection of anomalies	Ground, geological, geochemical and geophysical prospecting and surveys. Compilation, appraisal and selection of significant anomalies	Geological mapping and other surveys. Trenching, drilling and sampling. Appraisal of results, recommendations for further work, and selection of new targets	Stripping, trenching, mapping, sampling, drilling and down-hole geophysics. Initial mineral processing tests. Environmental and site surveys. Mineral resource estimation and inventory	Detailed mapping, sampling and drilling on surface or from underground. Systematic mineralogy and mineral processing tests. Detailed environmental and site surveys. Pre-feasibility studies	Pilot tests, engineering design and planning. Capital and operating costs for mining, mineral processing, infrastructure, environmental protection and restoration. Technical risk analysis. Pre-feasibility studies.	Market, prices, product development and financial studies. Environmental, economic, financial, and socio-political risk analysis. Pre-feasibility studies	Exhaustive due diligence review of all data, interpretations, plans and estimates. Evaluation of profitability, given the geological, technical, financial and qualitative risks, and the up-side factors.	Project management methods in a quality assurance perspective. Training program for personnel and detailed start-up plan to meet the requirements of this demanding period.	Production management methods to ensure continuous quality and efficiency improvements. Exploration, deposit appraisal and development of new zones or deposits on-mine-site and off-mine-site	Mine closure and decommissioning. Environmental restoration and monitoring
RESULTS	Maps, data bases, tools and models	Exploration projects	Regional anomalies	Local anomalies	Mineral showings	Mineral deposit,	Deposit appraisal project			Mining project	Mining complex	Mineral production	Restored site
MINERAL INVENTORY	UNDISCOVERED MINERAL POTENTIAL					INFERRED RESOURCE	DELIMITED MINERAL RESOURCE				MINERAL RESERVE		
	SPECULATIVE			HYPOTHETICAL			INDICATED	INDICATED AND MEASURED			PROVEN AND PROBABLE		
ESTIMATION ERROR (targeted margin of error of tonnage/grade estimates at the 90% confidence level)						± 100%	± 50%	Indicated: ± 50 to ± 30% Measured: ± 20 to ± 10% (often several sample grid dimensions are used in each category)			Proven (feasibility: ± 10%; mining: ± 5%)		
INVESTMENTS	Moderate	Low, but increasing multiple investments.					Larger and increasing multiple investments				Very large industrial investment		Full compliance
RISK LEVEL	Low	Very high, but decreasing risk of failure and financial loss					High, but decreasing risk of failure				Moderate to low industrial risk		

Sources: Modified by D.A. Cranstone, A. Lemieux and M. Vallée, February 25, 1994, from M. Vallée, 1992, *Guide to the Evaluation of Gold Deposits*, CIM Special Volume 45, p. 4, and *SOQUEM Annual Report*, 1976-77, pp. 4 and 5. Revised by M. Vallée and G. Bouchard, January 2001.

sufficient for six more years of production, but the Polaris and Nanisivik mines closed in 2002.

Copper

In December 2001, Canadian reserves of copper were estimated at about 6.7 Mt, or down by about 10% (-753 000 t) from a year earlier. The reduction in copper reserves was due to production without replacement of ore at almost all of the producing copper mines.

Molybdenum

Canadian reserves of molybdenum stood at 95 000 t in December 2001, or about 2% lower than in the previous year. Reserves at the Highland Valley mine increased slightly while reserves at the Huckleberry mine were maintained at the same level as in 2000, but reserves at the Endako mine were reduced by 13 000 t. All of the molybdenum mines are in British Columbia.

Nickel

In December 2001, there were some 4.3 Mt of nickel contained in Canadian mine reserves, down by approximately 9% from 2000 levels. This decrease is due largely to reserves deleted because of low prices at Inco Limited's Ontario and Manitoba divisions (-243 000 t) and at Falconbridge's Ontario operations. Reserves were increased slightly at Falconbridge's Raglan mine in Quebec.

Inco had some 3.5 Mt of nickel in Canadian reserves at the end of 2001, or about 80% of the national total. It is expected that development of the copper-nickel-cobalt deposits at Voisey's Bay in Labrador (announced in June 2002) will increase Canada's mineable reserves of nickel by 893 000 t.

Canadian Reserves by Province and Territory

Four provinces (Ontario, British Columbia, New Brunswick and Quebec) held dominant positions in terms of Canada's proven and probable mineable reserves of major metals in December 2001 (Table 4).

Ontario had 66% of the nickel, 53% of the gold and 50% of the copper, plus 21% of the silver and 20% of the zinc.

British Columbia had 100% of the molybdenum, 34% of the copper and 27% of the silver, plus 4% of the lead, 7% of the zinc and 16% of the gold.

New Brunswick had 92% of the lead, 29% of the zinc and 21% of the silver, plus 1% of the copper.

Quebec had 29% of the zinc, 22% of the gold, 8% of the copper, 13% of the nickel and 26% of the silver.

Manitoba had 21% of the nickel, 12% of the zinc and 4% of the gold, plus 6% of the copper and 4% of the silver.

Newfoundland and Labrador had less than 1% of the gold.

The Northwest Territories had 2% of the gold.

Nunavut had 3% of the lead, 2% of the zinc, less than 1% of the gold, and less than 1% of the silver.

Canadian Reserves by Industry Classification

Canadian mines are, to a large extent, polymetallic, a complexity that the North American Industry Classification System (NAICS) tends to oversimplify (Table 5).

Current mine reserves of gold in Canada are distributed through the various NAICS classes as follows: Gold and Silver Ore Mining, 78%; Copper and Zinc Ore Mining, 15%; Nickel-Copper Ore Mining, 5%; Lead-Zinc Ore Mining, 0.5%; and Other Metal Ore Mining, 1%.

Current mine reserves of silver in Canada are distributed through the various NAICS classes as follows: Gold and Silver Ore Mining, 41%; Copper-Zinc Ore Mining, 29%; Nickel-Copper Ore Mining, 8%; and Lead-Zinc Ore Mining, 22%.

Current mine reserves of copper in Canada are distributed through the various NAICS classes as follows: Gold and Silver Ore Mining, 2%; Copper-Zinc Ore Mining, 51%; Nickel-Copper Ore Mining, 45%; Lead-Zinc Ore Mining, 2%; and Other Metal Ore Mining, 1%.

Current mine reserves of molybdenum in Canada are contained in the NAICS classes as follows: Copper-Zinc Ore Mining, 37%; and Other Metal Ore Mining, 63%.

Current mine reserves of nickel in Canada are contained 99% in the NAICS class of Nickel-Copper Ore Mining and 1% in the NAICS class of Other Metal Ore Mining.

Current mine reserves of lead in Canada are contained in the NAICS classes as follows: Copper-Zinc Ore Mining, 6%; and Lead-Zinc Ore Mining, 94%.

Current mine reserves of zinc in Canada are contained in the NAICS classes as follows: Gold and Silver Ore Mining, 17%; Copper-Zinc Ore Mining, 50%; and Lead-Zinc Ore Mining, 33%.

Apparent Life of Canadian Reserves

The apparent life (life index) of mine reserves is usually calculated by dividing the total amount of metals remaining in mine reserves at the end of a given year by the corresponding amount of metals contained in the ores produced during that year. Similar calculations are often applied at the national level.

At the national level, life indices are but a very rough measure of the expected life of aggregate mine reserves and they are often misleading unless abnormal situations are recognized. Life indices based on proven and probable reserves do not make allowances for inferred extensions to reserves at current mines, gross additions that will accrue to current reserves from the likely development, in the foreseeable future, of known orebodies for which a production decision has yet to be made, or expected changes in production rates. Furthermore, life indices tend to overstate the apparent life of reserves when, for example, annual production is abnormally low due to strikes, cutbacks or suspensions at large establishments, or when significant increases in capacity resulting from new production decisions will be coming on stream, but only several years hence.

The apparent life indices for the major metals in Canada at the end of 2001 were 21 years for nickel, 10.5 years for copper, 9.5 years for molybdenum, 8.8 years for silver, 7 years for zinc, 6 years for gold and 5.5 years for lead.

Reserve Trends

Figure 2 and Table 6 show how Canadian reserves of copper, nickel, lead, zinc, molybdenum and silver have declined since the early 1980s. In contrast, gold reserves increased substantially until 1988 before beginning to decline. At the end of 2001, Canadian reserves of copper, nickel, lead, zinc, molybdenum and silver were all lower than at any time since Natural Resources Canada began keeping records (1977) and reserves of gold were lower than in any year since 1982.

The annual aggregate change in Canadian reserves is the net result of three main factors affecting individual mines (Figure 3): additions to reserves, deletions to reserves, and production. Additions to reserves are the result of new discoveries; of new geological, metallurgical, production or other information; of a decrease in production costs; or of a rise in commodity prices, all of which increase the quantity of mineral resources that are profitable to mine. Deletions to reserves are the result of new geological, metallurgical, production or other information; of increases in costs; or of decreases in commodity prices, all of which reduce the quantity of mineral resources previously counted in mine reserves that are now expected to be mined at a profit. Production is normally the main factor reducing the reserves at individual mines but, in 2001, low metal prices were also a significant factor in the reduction of ore reserves at producing mines.

RECENT PRODUCTION DECISIONS

Several criteria need to be met for a project to be considered here to have reached the production decision stage. In general, there needs to have been a positive production feasibility study, all of the necessary permits must have been obtained, financing must have been arranged, and directors must have approved construction.

During 2001, the only new production decision was for the Hammerdown gold deposit in Newfoundland and Labrador (Richmont Mines Inc., 5.9 t).

Inco Limited's Voisey's Bay deposit in Labrador was approved for production in June 2002, resulting in an increase of 524 000 t in the reserves of copper and an increase of 893 000 t in the reserves of nickel.

OUTLOOK

Given that the only new production decision during 2001 was the Hammerdown mine (5.9 t of gold) in Newfoundland and Labrador and that prices of most of the metals covered in this chapter remained low during 2002, it is probable that mine reserves of precious metals and most base metals will decline further during 2002. The decision in June 2002 by Inco Limited to place the Voisey's Bay copper-nickel-cobalt deposit in Labrador into production will increase copper reserves by 8% and nickel reserves by 21%.

Notes: (1) Information in this review was current as of February 11, 2003. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002CMY_e.htm..

NOTE TO READERS

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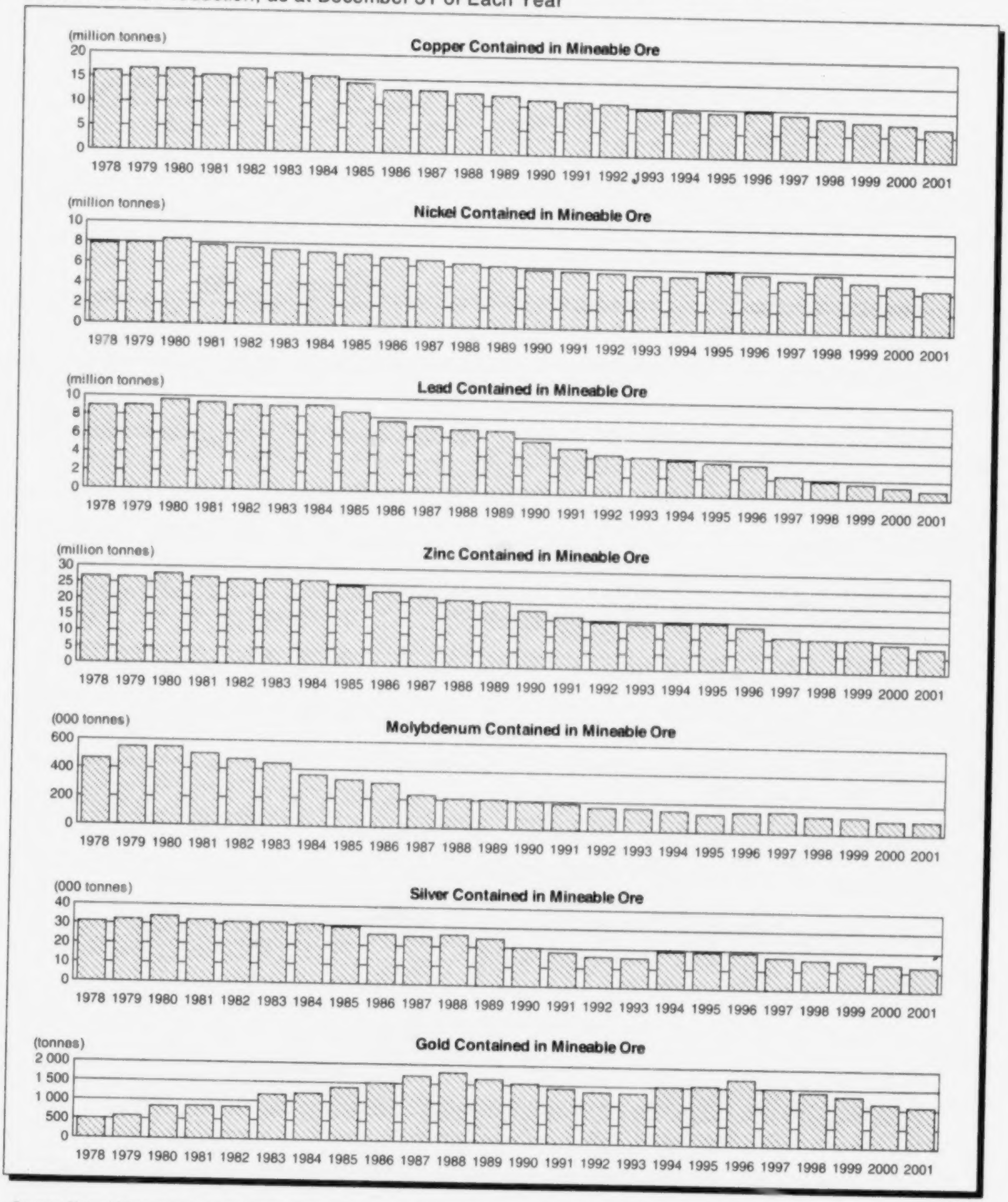
Figure 2

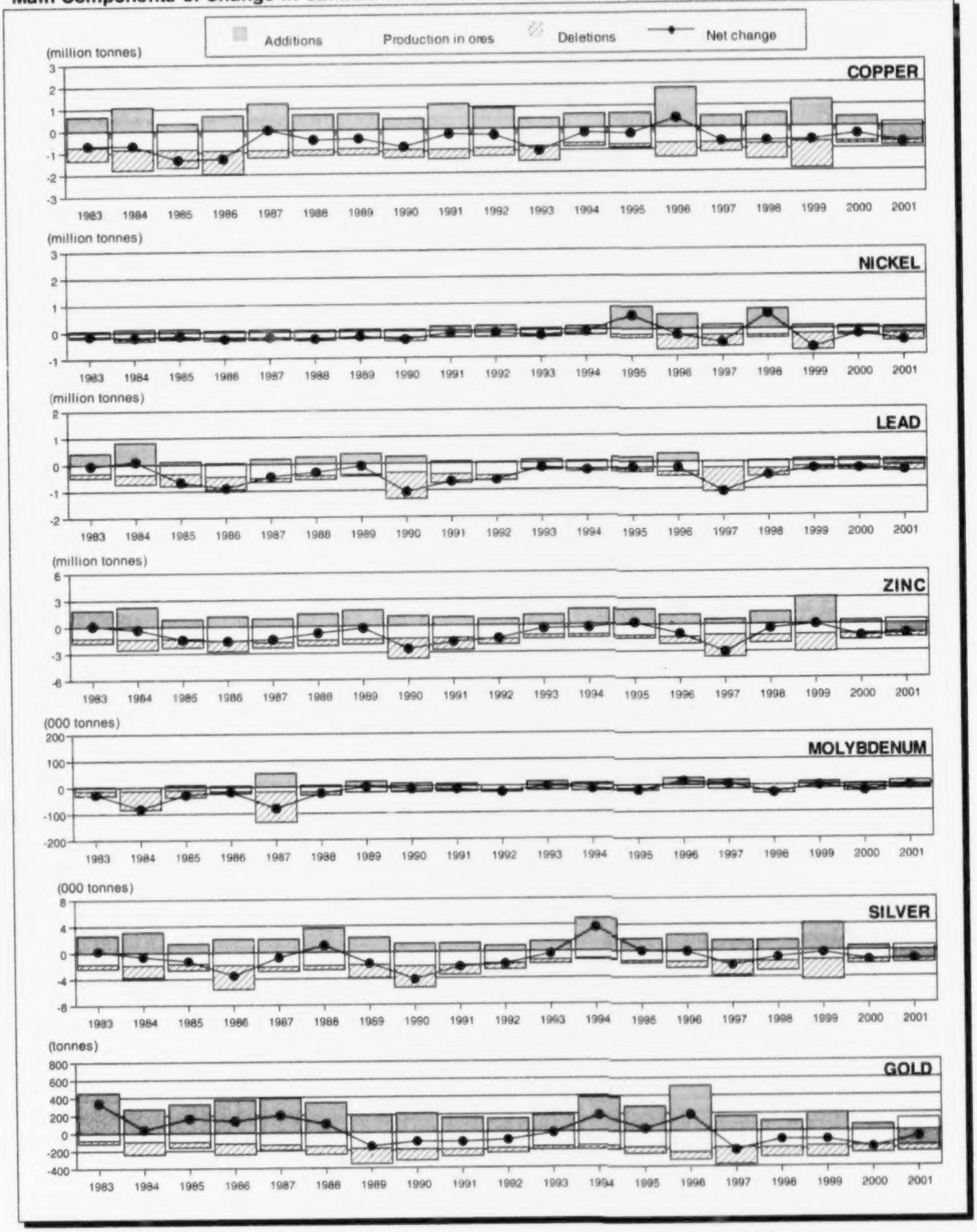
Canadian Reserves of Selected Major Metals, 1978-2001

Metal Contained in Proven and Probable Mineable Ore in Operating Mines and Deposits Committed to Production, as at December 31 of Each Year



Source: Natural Resources Canada, based on company reports and the Federal-Provincial/Territorial Survey of Mines and Concentrators.
Note: This series was revised during 1996.

Figure 3
Main Components of Change in Canadian Reserves of Selected Major Metals, 1983-2001



Source: Natural Resources Canada.

TABLE 1. MAIN COMPONENTS OF CHANGE DURING 2001 IN CANADIAN RESERVES OF SELECTED MAJOR METALS

Metal	Units	Revised Opening Metal Balance, January 2001	Metal in Ore Mined During 2001	Metal Apparently Written Off During 2001	Metal in New Reserves Found During 2001	Net Change During 2001	Closing Metal Balance, December 2001	% Change During 2001
Copper	000 t	7 419	-690	-200	151	-753	6 666	-10
Nickel	000 t	4 782	-209	-271	32	-447	4 335	-9
Lead	000 t	1 315	-178	-221	54	-345	970	-26
Zinc	000 t	8 876	-1 034	-502	468	-1 068	7 808	-12
Molybdenum	000 t	97	-10	-6	13	-3	95	-2
Silver	t	13 919	-1 426	-535	635	-1 326	12 593	-10
Gold	t	1 142	-171	-67	136	-72	1 070	-6

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.
Note: May not balance due to rounding.

TABLE 2. TONNAGES AND GRADES OF OPERATIONS INCLUDED IN CANADIAN RESERVES OF SELECTED MAJOR METALS, AS AT JANUARY 1, 2002

Tonnages classified by companies as "possible" are not included, nor are tonnages for which there is not a firm production decision. Confidential data have been suppressed from the details of this report.

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
NEWFOUNDLAND AND LABRADOR								
Hammerdown								
Richmont Mines Inc.								
Proven and probable	335 658							17.49
NEW BRUNSWICK								
Brunswick No. 12 Underground								
Noranda Mining and Exploration Inc.								
Proven	23 481 000	0.39		3.49	8.82		105.30	. .
Probable	1 949 000	0.25		3.62	9.34		94.20	. .
QUEBEC								
Beaufor								
Aurizon Mines Ltd.								
Louvem Mines Inc.								
Proven and probable	1 000 625						. .	7.20
Bell Allard								
Noranda Mining and Exploration Inc.								
Proven	1 853 000	1.23		0.12	12.56		38.50	0.60
Probable	317 000	0.98		0.13	19.59		40.40	0.33
Bouchard-Hébert								
Breakwater Resources Ltd.								
Proven and probable	3 219 000	0.60			4.90		33.00	1.00
Bousquet No. 2								
Barrick Gold Corporation								
Proven	800 000	0.23					4.60	5.90
Doyon								
Barrick Gold Corporation								
Cambior inc.								
Proven	3 505 362						. .	5.20
Probable	3 929 017						. .	5.60
Joe Mann								
Campbell Resources Inc.								
Reserves	297 284	. .					. .	10.42
Kiena								
McWatters Mining Inc.								
Proven	476 000						. .	3.02
Probable	13 000						. .	4.76
Langlois (Grevet)								
Cambior inc.								
Proven and probable	2 903 000	0.70			11.20		53.00	0.10
LaRonde (Dumagami)								
Agnico-Eagle Mines Limited								
Proven and probable	32 933 528	0.36			4.05		78.86	3.09

TABLE 2 (cont'd)

		Grade						
	Tonnes	Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
QUEBEC (cont'd)								
Louvicourt								
Aur Resources Inc.								
Novicourt Inc.								
Teck Corporation								
Proven	3 969 000	3.09			1.91		27.80	0.86
Probable	102 000	1.88			3.18		36.00	0.55
Raglan								
Falconbridge Limited								
Proven	7 136 000	0.81	3.05					
Probable	12 404 000	0.78	2.76					
Selbaie (Detour) A1 Open Pit								
Billiton Metals Canada Inc. (Gencor Ltd.)								
Proven	6 200 000	0.30		0.08	1.22		. .	0.24
Sigma No. 1								
McWatters Mining Inc.								
Proven	9 600 000						. .	2.60
Probable	5 479 000						. .	2.64
Sleeping Giant								
Aurizon Mines Ltd.								
Cambior inc.								
Proven	290 000						. .	12.30
Probable	125 000						. .	10.70
Troilus (Lac Frotet)								
Inmet Mining Corporation								
Proven	9 800 000	0.10					1.10	0.80
Probable	17 700 000	0.10					1.10	1.10
ONTARIO								
Campbell								
Placer Dome Inc.								
Proven	931 000						. .	17.60
Probable	1 010 000						. .	15.90
David Bell								
Homestake Canada Inc.								
Teck Corporation								
Proven	3 200 000						. .	10.44
Dome (including Paymaster)								
Placer Dome Inc.								
Proven	11 179 000						. .	1.10
Probable	14 417 000						. .	2.00
Eagle River								
River Gold Mines Ltd.								
Proven	428 000						. .	11.80
Probable	471 000						0.90	9.40
Edwards								
River Gold Mines Ltd.								
VenCan Gold Corporation								
Stockpile	6 000						0.50	. .
Falconbridge Sudbury Integrated Nickel Operations								
Falconbridge Limited								
Proven	9 906 000	1.28	1.51					
Probable	7 113 000	1.32	1.30					
Glimmer								
Apollo Gold Corporation								
Proven	302 538							8.45
Probable	475 244							9.21
Golden Giant								
Newmont Mining Corporation								
Proven and probable	3 229 561						1.03	9.94
Holloway								
Newmont Mining Corporation								
Proven and probable	3 424 605						. .	6.51
Holt-McDermott								
Barrick Gold Corporation								
Proven	115 212						. .	6.72
Probable	1 128 538						. .	7.37
Hoyle Pond								
Kinross Gold Corporation								
Proven	367 000						. .	13.31
Probable	554 000						. .	14.04
Inco Ontario Division								
Inco Limited								
Proven	107 000 000	1.40	1.40				. .	0.24
Probable	89 000 000	1.17	1.23				. .	0.34

TABLE 2 (cont'd)

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
ONTARIO (cont'd)								
Kidd Creek total								
Falconbridge Limited								
Proven	14 697 000	2.17			5.85		77.00	
Probable	10 285 000	2.25			6.98		54.00	
Lac des Iles (palladium-platinum)								
North American Palladium Ltd.								
Proven	59 940 000	0.06	0.05					0.12
Probable	33 561 000	0.05	0.05					0.12
Mishi								
River Gold Mines								
Probable	104 000							3.75
Musselwhite								
Placer Dome Inc.								
TVX Gold Inc.								
Proven	6 954 000							5.70
Probable	1 820 000							4.80
Red Lake (Arthur W. White)								
Goldcorp Inc.								
Proven and probable	2 902 991						..	45.94
Williams								
Barrick Gold Corporation								
Teck Corporation								
Proven (underground)	8 830 000						..	5.83
Proven (open pit)	16 560 000						..	1.77
Probable (underground)	6 580 000						..	5.17
Probable (open pit)	4 360 000						..	1.92
MANITOBA								
777								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	9 800 000	2.80			4.60		..	..
Callinan								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	2 400 000	1.10			4.50		..	..
Chisel Lake North								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	2 100 000	..		..	9.60		..	
Inco Manitoba Division								
Inco Limited								
Proven	22 000 000	0.13	2.06				..	..
Probable	18 000 000	0.16	2.42				..	..
New Britannia (Nor Acme/Snow Lake)								
High River Gold Mines Ltd.								
TVX Gold Inc.								
Reserves	2 292 000						..	4.86
Trout Lake								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	4 500 000	1.20			4.40		..	..
SASKATCHEWAN								
Konuto Lake mine								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	700 000	4.20			1.60		..	..
Seabee								
Claude Resources Inc.								
Proven	123 400						..	5.76
Probable	486 600						..	8.49
BRITISH COLUMBIA								
Endako								
Nissho Iwai Corporation								
Thompson Creek Mining Company								
Endako pit	55 400 000					0.07		
Denak pit	10 500 000					0.08		
Stockpile	26 400 000					0.05		
Eskay Creek								
Barrick Gold Corporation								
Proven	685 832						..	58.18
Probable	607 814						..	25.17

TABLE 2 (cont'd)

		Grade						
	Tonnes	Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
BRITISH COLUMBIA (cont'd)								
Highland Valley								
Cominco Ltd.								
Highmont Mining Company								
Rio Algom Limited								
Teck Corporation								
Proven	292 500 000	0.41				0.01	. .	. .
Probable	53 600 000	0.44				. .	. .	0.01
Huckleberry								
Imperial Metals Corporation								
Mitsubishi-Dowa-Furukawa-Marubeni								
Probable	56 498 000	0.49				0.01	2.81	0.06
Kemess South								
Imperial Metals Corporation								
Proven	132 587 792	0.23						0.70
Mount Polley								
Imperial Metals Corporation								
Sumitomo								
Probable	31 909 452	0.36						0.34
Myra Falls								
Boliden Limited								
Proven	6 470 000	1.40		0.50	7.50		46.00	1.40
Probable	1 930 000	1.10		0.50	5.20		43.00	1.50
NORTHWEST TERRITORIES								
Con								
Miramar Mining Corporation								
Proven	258 000						. .	11.31
Probable	602 000						. .	12.00
Giant Open Pit-Giant Underground								
Miramar Mining Corporation								
Proven	27 000						. .	13.02
Probable	67 000						. .	11.52
NUNAVUT								
Lupin								
Echo Bay Mines Ltd.								
Proven and probable	1 240 122						8.78	. .
Nanisivik								
Breakwater Resources Ltd.								
Proven and probable	772 000			0.40	7.40		30.00	
Polaris								
Teck Cominco Limited								
Proven	780 000			2.90	12.60			

Source: Natural Resources Canada, based on published company reports.
. . Not available in published reports or estimated by author.
Notes: One tonne (t) = 1.1023113 short tons. One gram per tonne (g/t) = 0.02916668 troy oz per short ton.

TABLE 3. PRODUCTION DECISIONS ADDED TO CANADIAN RESERVE TOTALS AS AT DECEMBER 31, 2001

Project	Operators and Major Partners	Province	Metals
Hammerdown	Richmont Mines Inc.	N.L.	Gold

Source: Natural Resources Canada, based on company reports.

TABLE 4. CANADIAN RESERVES OF SELECTED MAJOR METALS BY PROVINCE AND TERRITORY, AS AT DECEMBER 31, 2001

Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed to Production

Metal	Units (3)	N.L.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	B.C.	Yukon	N.W.T.	Nunavut	Canada (5)
Copper	000 t	–	–	96	512	3 363	417	29	2 249	–	–	–	6 666
Nickel	000 t	–	–	–	560	2 882	893	–	–	–	–	–	4 335
Lead	000 t	–	–	890	8	–	4	–	42	–	–	26	970
Zinc	000 t	–	–	2 253	2 266	1 578	958	11	586	–	–	155	7 808
Molybdenum	000 t	–	–	–	–	–	–	–	95	–	–	–	95
Silver	t	–	–	2 656	3 250	2 720	528	11	3 391	–	4	34	12 593
Gold (4)	t	6	–	2	239	572	46	6	178	–	20	2	1 070

Source: Natural Resources Canada, based on company reports and the Federal-Provincial/Territorial Survey of Mines and Concentrators.
– Nil or less than one unit.
(1) No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes geological reserves for some mines that do not report mineable ore. (2) Includes metal in mines where production has been suspended temporarily. (3) One tonne (t) = 1.1023113 short tons = 32 150.746 troy oz. (4) Excludes metal in placer deposits because reserves data are generally unavailable. (5) May not balance due to rounding at the provincial/territorial level.

TABLE 5. CANADIAN RESERVES OF SELECTED MAJOR METALS BY INDUSTRY, AS AT DECEMBER 31, 2001

Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed to Production

	NAICS no. (5)	Gold and Silver Ore Mining 212220	Copper-Zinc Ore Mining 212233	Nickel-Copper Ore Mining 212232	Lead-Zinc Ore Mining 212231	All Other Metal Ore Mining 212299	Canada (6)
	(Units (3))						
Copper	000 t	149	3 377	2 972	116	53	6 666
Nickel	000 t	–	–	4 288	–	47	4 335
Lead	000 t	–	54	–	916	–	970
Zinc	000 t	1 334	3 908	–	2 566	–	7 808
Molybdenum	000 t	–	35	–	–	60	95
Silver	t	5 116	3 695	997	2 786	–	12 593
Gold (4)	t	833	163	58	5	11	1 070

Source: Natural Resources Canada, based on company reports and the Federal-Provincial/Territorial Survey of Mines and Concentrators.
– Nil or less than one unit.
(1) No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. (2) Includes metal in mines where production has been suspended temporarily. (3) One tonne (t) = 1.1023113 short tons = 32 150.746 troy oz. (4) Excludes metal in placer deposits because reserves data are generally unavailable.
(5) NAICS = North American Industry Classification System. (6) May not balance due to rounding at the NAICS level.

TABLE 6. CANADIAN RESERVES OF SELECTED MAJOR METALS AS AT DECEMBER 31 OF EACH YEAR, 1977-2001

Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed to Production

Year	Copper	Nickel	Lead	Zinc	Molybdenum	Silver	Gold (3)
	(000 t)	(000 t)	(000 t)	(000 t)	(000 t)	(t)	(t)
1977	16 914	7 749	8 954	26 953	369	30 991	493
1978	16 184	7 843	8 930	26 721	464	30 995	505
1979	16 721	7 947	8 992	26 581	549	32 124	575
1980	16 714	8 348	9 637	27 742	551	33 804	826
1981	15 511	7 781	9 380	26 833	505	32 092	851
1982	16 869	7 546	9 139	26 216	469	31 204	833
1983	16 214	7 393	9 081	26 313	442	31 425	1 172
1984	15 530	7 191	9 180	26 000	361	30 757	1 208
1985	14 201	7 041	8 503	24 553	331	29 442	1 373
1986	12 918	6 780	7 599	22 936	312	25 914	1 507
1987	12 927	6 562	7 129	21 471	231	25 103	1 705
1988	12 485	6 286	6 811	20 710	208	26 122	1 801
1989	12 082	6 092	6 717	20 479	207	24 393	1 645
1990	11 261	5 776	5 643	17 847	198	20 102	1 542
1991	11 040	5 691	4 957	16 038	186	17 859	1 433
1992	10 755	5 605	4 328	14 584	163	15 974	1 345
1993	9 740	5 409	4 149	14 206	161	15 576	1 333
1994	9 533	5 334	3 861	14 514	148	19 146	1 513
1995	9 250	5 832	3 660	14 712	129	19 073	1 540
1996	9 667	5 623	3 450	13 660	144	18 911	1 724
1997	9 032	5 122	2 344	10 588	149	16 697	1 510
1998	8 402	5 683	1 845	10 159	121	15 738	1 415
1999	7 761	4 983	1 586	10 210	119	15 368	1 326
2000	7 419	4 782	1 315	8 876	97	13 919	1 142
2001	6 666	4 335	970	7 808	95	12 593	1 070

Source: Natural Resources Canada, based on company reports and the Federal-Provincial/Territorial Survey of Mines and Concentrators.

(1) No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. (2) Includes metal in mines where production has been suspended temporarily. (3) Excludes metal in placer deposits because reserves data are generally unavailable.

Note: One tonne (t) = 1.1023113 short tons = 32 150.746 troy oz.

Mineral Exploration, Deposit Appraisal and Mine Complex Development Activity in Canada

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INTRODUCTION

This review provides analytical highlights and describes mineral resource development activities from primary exploration to mine production in Canada for the year 2002 with emphasis being placed on mineral exploration and deposit appraisal expenditures. Also briefly discussed are the 2003 revised spending intentions, which were compiled as of August 2003. For a more detailed description of the survey results and other exploration indicators, refer to the tables and graphs presented at the end of this chapter.

Expenditures are compiled from the federal-provincial/territorial Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures, which is described briefly in the Background section at the end of this chapter. This annual survey of exploration and mining companies provides an accurate measure of the overall mineral resource development activity in Canada. In 2002, the response rate to that survey was 96.8%. The remaining 3.2% of respondents account for only 0.5% of estimated expenditures. The results were compiled from the reports of 651 active company project operators and the reports of some prospectors or groups of prospectors. The prospectors and 537 of the companies (versus 482 of the companies in 2001) reported that they were active in mineral exploration while 66 companies were active in deposit appraisal and 105 in mine complex development. (Note: Some companies are involved in more than one work phase at the same time.)

TRENDS AND PERSPECTIVE

General Trend

Exploration and deposit appraisal expenditures by both junior and senior companies (definitions are provided in Table 16) have increased since 2001. In that year, expenditures were $512.9 million. They climbed to $573.4 million in 2002 and will likely top $684.2 million in 2003, based on company revised intentions. From the year 2000 up to and including 2003, expenditures have increased by 37.8% with Ontario having the highest share (average share of 23.3%) of expenditures recorded in Canada for the period 2000-2002. In 2003, close to one third of all exploration and deposit appraisal expenditures are expected to be concentrated in Ontario. Mirroring the trend in Ontario, the total Canadian increase in expenditures is mainly attributable to more significant off-mine-site deposit appraisal activities than on-mine-site exploration activities, even though the latter also increased. In 2003, off-mine-site exploration activities are the main contributors to the anticipated sizeable increase.

At the same time as exploration and deposit appraisal spending increased over the period 2001-03, a similar trend was registered by junior and senior companies (Tables 3a, b and c). Spending by juniors increased by 7.3% in 2002 compared to 2001 (reaching $190.8 million) and is expected to increase by a further 47.1% in 2003 (reaching an expected $280.7 million). Senior increases were more modest at 14.2% and 5.5% for the years 2002 and 2003, respectively. In 2002, the merger of Hope Bay Gold Corp. with Miramar Mining Corp. resulted in a new company, Miramar Hope Bay Ltd., operating the Hope Bay project in Nunavut. This project takeover affected the classification of the expenses reported under the senior category, which may have partly contributed to that year's increase in senior expenditures. In 2003, four junior companies became committed to production and, as a result, their respective expenditures are now reported under the senior category. Close to 90% of all junior expenditures were dedicated to off-mine-site exploration for these years, amounting to $172.4 million in 2002 and an expected $246.3 million in 2003.

Factors of Influence

As outlined in Figure 2c, different factors may have an effect on the level of exploration and deposit appraisal activity in Canada and thus on the overall level of mineral resource development activity. Different factors, such as metal prices, main discoveries (see Diamond Interest below), and federal and other regional tax incentive measures, are associated with some of the survey results and will be discussed briefly. While it is clear that each of these factors is important, it is difficult to draw definite conclusions about their relative importance because of the complexity of how these and other factors are interrelated.

Metal Prices

Metal prices have a major influence on mineral resource development expenditures. As shown by the exploration trend recorded since 1969 in Figure 2a, Canada is just coming out of the fourth downturn in expenditures with a low recorded in 1999. Other depressed expenditure years were 1972, 1983 and 1992 when low metal prices were recorded. The shorter-than-normal period preceding the 1999 low in total expenditures should be noted, when metal prices seemed to fluctuate more quickly than ever before. The General Review (Chapter 1) describes in detail the trends in metal prices and the associated economic conditions.

Most metal prices improved in 2003. In 2001, the price of copper averaged US$0.716/lb; in 2002, it averaged US$0.707/lb. As of mid-November 2003, copper traded at almost US$0.93/lb. Over the past two years, nickel averaged US$2.70/lb in 2001 and US$3.07/lb in 2002. At nearly US$5.50/lb in mid-November 2003, nickel reached its highest level since 1989 as a result of strong demand from China, reduced inventories and limited supply. Lead and zinc prices did not fare quite as well in 2003, but are also strengthening with lead prices approaching US$0.30/lb and zinc prices reaching US$0.41/lb by mid-November. Zinc prices declined from an average of US$0.51/lb in 2000 to US$0.40/lb in 2001 and then to US$0.35/lb in 2002. Results from the survey reveal that combined base-metal exploration and deposit appraisal expenditures for 2002 are quite stable since the last major decrease in 1999 (Table 12). However, an increase in deposit appraisal activity, mainly from the Voisey's Bay nickel-cobalt project (operated by Voisey's Bay Nickel Company Limited), conceals an overall slowdown in base-metal exploration. An improvement has been recorded in the mine complex development phase (excluding capital and repair expenditures) (Figure 1b). Again, the "go ahead" decision near the end of 2002 at the Voisey's Bay mine development project had a clear impact on this increase. The 2003 base-metal exploration plus deposit appraisal expenditures are expected to reach $161.2 million, an important increase from the $138.8 million recorded in 2002. Off-mine-site exploration activity at the Nickel Rim project (operated by Falconbridge Limited) in Ontario will also be partly responsible for this increase.

Gold prices have been rising steadily since the beginning of 2001, going from about US$265/oz at the beginning of 2001 to over US$330/oz at the end of 2002, a trend that has continued into 2003. In mid-November, gold traded at almost US$400/oz. At $176.0 million, gold exploration and deposit appraisal expenditures in 2002 represent 82.7% of all precious-metal expenditures and an increase of 42.9% over the $123.2 million recorded for gold expenditures in 2001. The increase in gold expenditures for 2002 can be explained by more major gold projects being active that year. For example, 33 gold projects each with over $1 million in expenditures, for a total of $109 million, accounted for 76% of all gold expenditures in 2002. Among those 33 projects, 12 were for on-mine-site activities for a total of $55 million. The two main on-mine-site projects were the Red Lake mine in Ontario (operated by Goldcorp Inc.) and the Doyon mine in Quebec (operated by Cambior Inc.). The two main off-mine-site projects were the Hope Bay project (operated by Miramar Hope Bay Ltd.) and the Meadowbank project (operated by Cumberland Resources Inc.), both located in Nunavut. This compares to 20 major gold projects for a total of $74 million in 2001, representing 60% of all gold expenditures, including 10 on-mine-site projects for a total of $40 million. It is also interesting to note that 27 former gold mines (among those, 15 in Ontario and 5 in British Columbia) have been targeted for exploration and deposit appraisal activity from a total of about 44 former mines being re-examined across Canada. Thirteen are former base-metal mines, two are former silver mines, and two are former nonmetal mines. Mine complex development expenditures for precious metals have also increased by 23.8%, but a corresponding increase in capital and repair investment has not occurred. In 2003, precious-metal exploration and deposit appraisal expenditures are also expected to continue to increase and reach close to $285 million, up from $213 million in 2002.

Platinum prices continued to be high at over US$700/oz in 2002 and have risen steadily through 2003 due to strong sustained demand in the motor vehicle and jewellery sectors. However, oversupply has affected the palladium market. Most palladium is produced as a by-product of platinum mining. Its price has declined from averages of US$604/oz in 2001 to US$337/oz in 2002 to about US$200/oz through 2003. The current low price may, however, encourage some users of platinum to switch back to palladium. Total exploration and deposit appraisal expenditures for all platinum group metals (PGM) have declined by 13.3% from $29.9 million in 2001 to $25.9 million in 2002.

The price of uranium has increased over the last few years, averaging US$8.80/lb U_3O_8 in 2001, US$9.89/lb in 2002 and US$11.02/lb in October 2003. The September 2003 month-end price of uranium at US$12.20/lb was the highest since the end of 1996. Uranium off-mine-site exploration expenditures themselves increased from $13.7 million in 2001 to $16.8 million in 2002, and are expected to be about the same in 2003. The large supply of secondary uranium may curtail further strong activity in the search for new deposits. The Cigar Lake deposit (operated by Cameco Corporation) in Saskatchewan is still nearing the development stage waiting for permits to be issued; production is expected to start in 2006. Capital and repair expenditures for uranium and coal account for the only expenditure increases in 2002.

Diamond Interest

Another factor of influence is the impact of important discoveries of diamonds (associated with a favourable geology), reflected in the level of claim-staking activity and the resulting exploration rush. For example, the diamond discovery of 1992 in the Northwest Territories that led to the opening of the first diamond mine in Canada in October 1998 helped boost the overall amount of exploration activity in Canada. Diamond's share of the total Canadian exploration and deposit appraisal expenditures rose from 18.2% in 1993 to 28.2% in 2002. The expenditures increased from $144.7 million in 2001 to $161.6 million in 2002 and will possibly reach $146.7 million in 2003. For the exploration component only, $100.6 million was spent in 2002 compared to $95.5 million in 2001. Capital expenditures alone accounted for $459.7 million in 2002 compared with $531.4 million in 2001, placing diamonds first as the leading mineral commodity for that type of spending (Figure 1b, Table 5). Those expenditures decreased when Diavik started producing in 2003. In 2002, four projects were at the deposit appraisal phase: Jericho (operated by Tahera Corporation) in Nunavut, Snap Lake and Gahcho Kue (both operated by De Beers Canada Mining) in the Northwest Territories, and Victor (also operated by De Beers Canada Mining) in Ontario. At Ekati (operated by BHP Billiton Diamonds), deposit appraisal on at least seven kimberlites in the Core and Buffer zones is still being conducted. In 2002, as in 2001, the total for deposit appraisal expenditures for diamonds surpassed that of any other mineral commodity (Figure 8b, Table 13b). Some other types of discoveries that may have triggered a subsequent exploration rush are included in Figure 2c.

If market conditions remain favourable, diamonds will continue to contribute to a strong exploration effort, leading to the discovery of more diamond deposits in many parts of the country. Canada not only has a recognized geological potential for diamonds, but is also rich in high-quality diamonds, as reflected in their average selling price. The average price per carat for a Canadian-mined diamond was the third highest in the world in 2001 and 2002, surpassed only by Namibia and Angola. (For more information, refer to Statistics Canada catalogue no. 11-621-MIE, no. 008, *Diamonds Adding Lustre to the Canadian Economy*.)

Tax Incentive Measures

In addition to periods of improved commodity prices and important discoveries, Canada has benefited from the compounded effect of different incentive measures, especially during the peak years of exploration and deposit appraisal expenditures, 1987 and 1988 (Figures 2a and 2c, Table 3a), resulting principally from the Canadian Mining Exploration Depletion Allowance (MEDA) that was put in place in 1983 and phased out in 1988. Since October 2000, the federal government has introduced a 15% Investment Tax Credit for Exploration (ITCE) aimed at assisting junior exploration companies to obtain flow-through-share (FTS) financing for their off-mine-site exploration programs. Some provincial and territorial governments have also introduced their own tax credit programs, some of which are harmonized with the federal ITCE.

The impact of government initiatives since 2000 still remains to be fully assessed. Indications for 2002 and especially 2003 are that these initiatives have contributed somewhat to increased junior off-mine-site exploration spending, as described above. A compilation of publicly available information shows that $202 million was raised through FTS financing in 2002, compared to $110 million in 2001. Indications for 2003 are that those amounts will easily be surpassed.

Appendix 1 summarizes the main tax incentive measures currently available in Canada. The possible impact of these measures can be observed in the junior expenditure trends described below.

Provincially (Table 15a), junior exploration and deposit appraisal expenditures increased between 2001 and 2002 in Ontario (up $11.3 million to $51.0 million), British Columbia (up $9.8 million to $28.1 million), and Newfoundland and Labrador (up $3.8 million to $11.0 million). Increases were less significant in the Yukon (up $1.3 million to $6.8 million) and Quebec (up $2.1 million to $32.1 million). Small increases were registered for Nova Scotia and Alberta. Expenditures in the other provinces and territories, including Manitoba and Saskatchewan with special incentives, declined from 2001 to 2002. For junior companies, the trend in off-mine-site exploration is the same with an increase of 9.2% since 2001.

A major increase of 42.9% in junior off-mine-site exploration expenditures is anticipated in 2003. Increases are expected everywhere except in New Brunswick and Alberta. In decreasing order of importance, 65.9% of the net increase originates from British Columbia, Quebec, Ontario and the Yukon. Worth mentioning are the important increases of 182.1% and 121.4% anticipated for Nova Scotia and Saskatchewan, respectively. In Nova Scotia, several closed gold mines are being explored by juniors, including the former Mooseland gold mine by Azure Resources Corp., which also operates the former Dufferin and Miller Lake gold mines. Many other gold properties are also being revisited by True Metallic Explorations, Aurogin Resources and, more recently, Acadian Gold Corp., which has acquired six old gold properties. As for Saskatchewan, Shore Gold Inc. is sinking a shaft on the Star diamond kimberlite there in order to recover a large bulk sample. In 2003, juniors spent more than seniors in off-mine-site exploration in Newfoundland and Labrador, Nova Scotia, New Brunswick, Quebec, British Columbia, the Yukon and Nunavut.

There was an increase from the previous year in the total number of junior project operators in 2002 as 463 companies were active (including 32 companies involved in deposit appraisal activities, of which some were also active in exploration at the same time as being involved with deposit appraisal). This is compared to 400 junior operators (including 40 involved in deposit appraisal activities) that were active in 2001.

Junior companies have traditionally explored off-mine-site for precious metals. Diamonds rank as the third most-sought mineral commodity after base metals in 2000 and 2001, but in 2002 diamonds moved up to the position of second most-sought mineral (Table 14). The main exploration (off-mine-site) target for seniors is normally base metals, but in 2002 diamonds ranked first ahead of base metals.

Exploration Success

More discoveries being made (Figure 2c), more projects under deposit appraisal, and new mines being developed are some measures of the success of exploration activities that are taking place. Analysis of these factors can yield an insight into trends in the state and health of exploration in Canada.

This survey identifies how deposit appraisal (advanced) off-mine-site projects compare with mine openings. For more information on Canadian mine openings, closings, expansions, extensions and new mine development, see Chapter 5. In 2002 (Figure 9), there was an improvement in both the number of advanced projects and mine openings. The correlation between advanced off-mine-site projects and mine openings has its shortcomings and will not be discussed. However, it is known that the deposit appraisal phase can last between two and seven years before a project enters the mine complex development phase.

The total number of base-metal advanced projects declined by six in 2002 while the total number of projects for the "others" category (including uranium, coal, other metals, and iron deposits) increased by seven. Two diamond projects were also classified as deposit appraisal off-mine-site in 2002. As a result, the total number of deposit appraisal off-mine-site projects increased by three in 2002. This short analysis shows that specific advanced projects tend to have a fairly high turnover rate. Overall, in 2002, three projects were added as the result of the introduction of 27 new deposit appraisal off-mine-site projects (including 8 reactivated projects) less 2 projects that moved into the mine complex development phase, 2 projects that were added to mine plans, and 20 projects that were put on hold or returned to the exploration phase.

Moreover, the proportion of advanced projects becoming mines is also very low. According to survey results in 2002, the number of off-mine-site deposit appraisal projects entering the mine complex development phase reached 3.0% of all off-mine-site deposit appraisal projects listed in 2001 (2 projects in 2002 out of a total of 67 off-mine-site deposit appraisal projects in 2001) compared to 3.5% in 2001 from the 2000 list of advanced projects (3 projects in 2001 out of a total of 86 projects in 2000). It must be noted that all those projects have not yet reported important production feasibility studies and that the deposit appraisal phase starts with the definition of a mineral deposit (Table 18). Further investigation of this type of expenditure may reveal higher percentages. The number of off-mine-site exploration projects entering the deposit appraisal phase in 2002 is about 1.2% compared to roughly 1.4% in 2001. The exact number of active properties at the off-mine-site exploration phase may sometimes be underestimated since some companies have difficulty in providing a breakdown of expenditures by property.

Table 17 also provides a breakdown of the number of advanced off-mine-site projects by province/territory and by junior and senior company. In 2002, 35 projects were operated by junior companies and 35 were operated by senior companies, compared to 45 by juniors and 22 by seniors in 2001. Except in Nova Scotia and the Yukon, the cost per project in 2002 is higher for seniors. There were no advanced projects operated by seniors in Manitoba that year. The most expensive ones are diamond projects in the Northwest Territories.

Total Mineral Resource Development Expenditures

Total mineral resource development expenditures (Figures 1a and 1b, Table 1), including repair and maintenance costs, decreased from $4.6 billion in 2001 to $4.2 billion in 2002. The major drop occurred in Quebec where three major mining construction projects were completed in 2001: the IOC pellet plant in Sept-Îles (operated by Iron Ore Company of Canada), the expansion of the Raglan mine in Ungava (operated by Société minière Raglan du Québec Limitée), and the Magnola metallurgical plant in the Eastern Townships (operated by Métallurgie Magnola Inc.), which subsequently closed in 2003. When considering all investment costs except repair and maintenance, which are not available for 2003, expenditures were expected to decrease slightly to $2.6 billion (capital cost contributing $1.2 billion) compared with $2.7 billion (capital cost contributing $1.3 billion) in 2002. With construction at the Diavik mine (operated by Diavik Diamond Mines Inc.) completed in 2003, the Voisey's Bay project is taking over as the major contributor to capital expenditures, but not yet at the same scale.

CONCLUSION

It is encouraging that the levels of exploration and deposit appraisal in Canada for 2002 and 2003 are increasing after remaining fixed at around $500 million in 1999, 2000 and 2001. The impact of the tax measures put in place since 2000 by different governments has not yet been fully assessed, but junior company expenditures for off-mine-site activities appear to have benefited from those measures in 2003, and will probably benefit in 2004 as the FTS financing continues to improve.

With the U.S. economy showing some signs of strength along with that of Japan, there is optimism for the world economic situation. As a consequence, industrial demand for commodities will likely improve, helping to boost prices for both base metals and precious metals. As mentioned previously, China is significantly fuelling the demand for metals. Overall, the demand is taking place at a time when there are virtually no new sources of supply. However, in Canada, the diamond project success stories based on Canada's geological potential and the quality of the gemstone mined will continue to encourage the exploration industry. Four projects are at the deposit-appraisal stage in 2002 (not to mention other pipes under deposit appraisal at the Ekati diamond mine). The second Canadian diamond mine (Diavik) started production in January 2003.

Furthermore, the annual survey of world mineral exploration by the Metals Economic Group (MEG) for 2002 indicates that, for the first time since 1992, Canada moved into first place in the world as a recipient of exploration expenditures, followed by Australia, the United States and Peru in that order. For additional information on Canadian mineral exploration and discovery analysis, refer to Chapter 4.

BACKGROUND INFORMATION ON MINERAL RESOURCE DEVELOPMENT STATISTICS

Natural Resources Canada (NRCan) coordinates the collection of all statistics for off-mine-site and on-mine-site expenditures for the exploration and deposit appraisal phases and the mine complex development phase. Statistics Canada coordinates the collection of detailed on-mine-site statistics on capital, repair and maintenance expenditures reported by producers at the mine complex development phase. NRCan and Statistics Canada cooperate with the provinces and territories to collect, assemble and publish the comprehensive national mineral resource development statistics presented in this review. These are compiled from the annual federal-provincial/territorial Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures. For the 2002 survey year, the questionnaire has been modified to integrate the revised spending intentions for 2003. To protect the confidential data provided by respondents, only aggregate statistics are released.

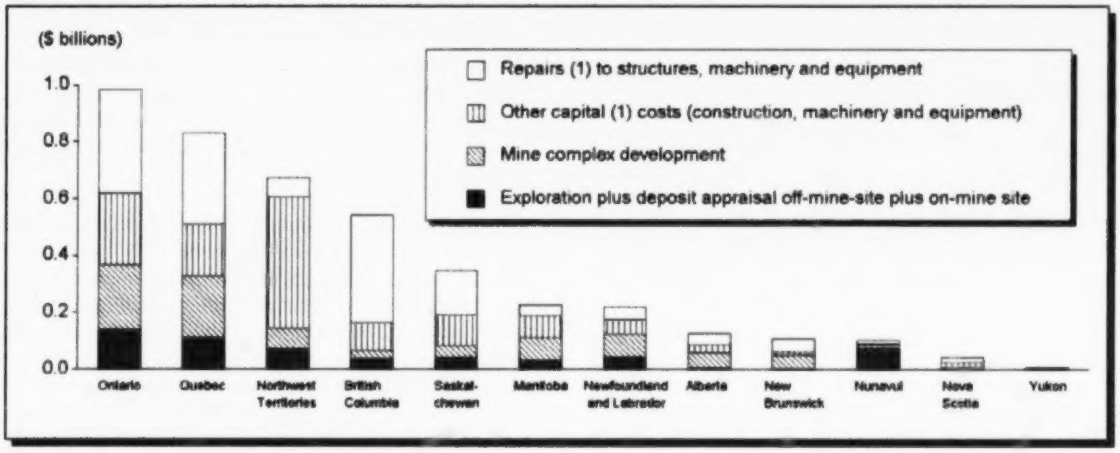
New definitions of work phases for mineral resource development were introduced in the 1997 survey. They provide a more complete and accurate coverage of project evolution from exploration to mine production. Table 18 describes the mineral resource development and mining process model upon which the new definitions are based. Specific definitions by category of expenditures are available on NRCan's exploration web site at http://mmsd1.mms.nrcan.gc.ca/mmsd/exploration/default_e.asp.

Notes: (1) Information in this review was current as of August 2003. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002CMY_e.htm.

NOTE TO READERS

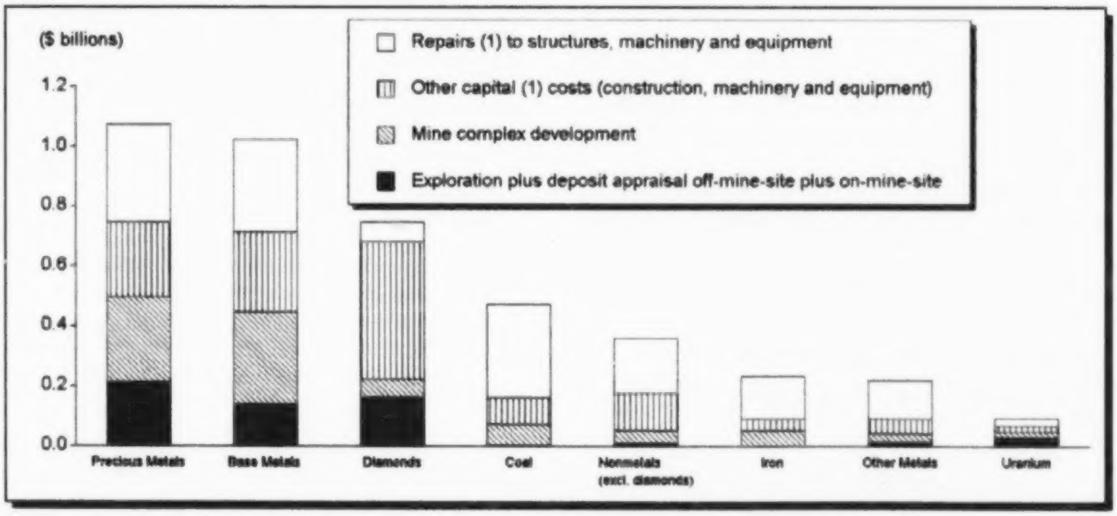
The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 1a
Total Mineral Resource Development Expenditures in Canada, by Province and Territory, 2002
$4.2 Billion



Source: Natural Resources Canada, from a federal-provincial territorial survey of mining and exploration companies.
(1) Includes expenditures related to exploration (0.7%), deposit appraisal (0.9%) and mine complex development (98.4%).

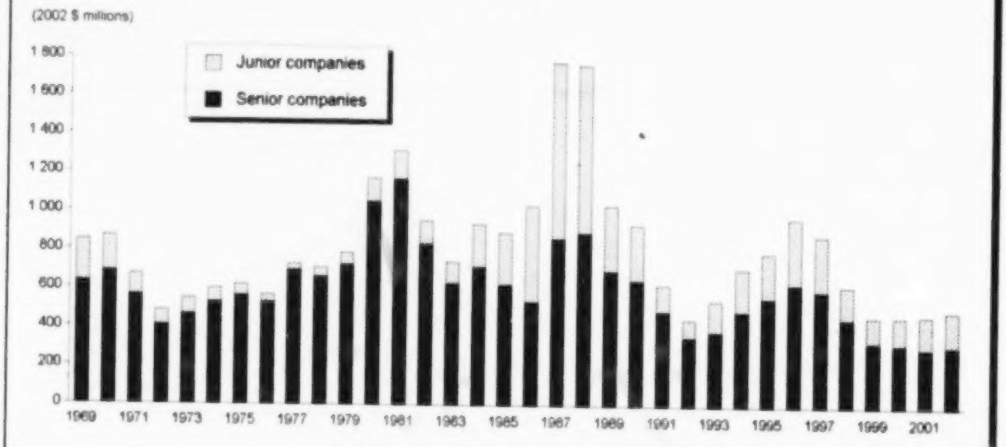
Figure 1b
Total Mineral Resource Development Expenditures in Canada, by Commodity Sought, 2002
$4.2 Billion



Source: Natural Resources Canada, from a federal-provincial territorial survey of mining and exploration companies.
(1) Includes expenditures related to exploration (0.7%), deposit appraisal (0.9%) and mine complex development (98.4%).

Figure 2a

Exploration Plus Deposit Appraisal Expenditures, (1) **Field and Overhead** (2) **Costs, by Junior and Senior Companies, 1969-2002**



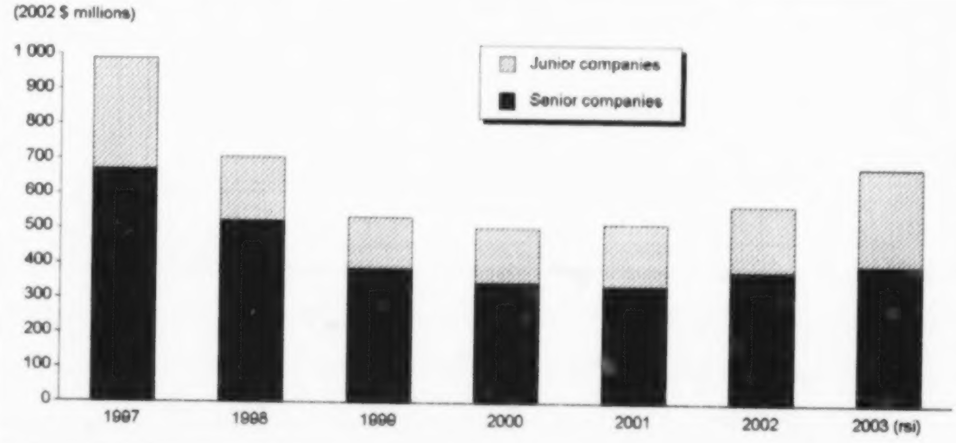
Sources: Natural Resources Canada and Statistics Canada, from a federal/provincial-territorial survey of mining and exploration companies.

(1) Includes on-mine-site plus off-mine-site activities. (2) Overhead costs include mineral leases, claims and property taxes, and project-related head office expenditures.

Notes: Total exploration expenditures for 1975-81 are overstated by an average of about 17% relative to earlier and later years because of changes to the methodology used by Statistics Canada over the years. Up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were reported under exploration (broadly speaking).

Figure 2b

Exploration Plus Deposit Appraisal Expenditures, (1) **by Junior and Senior Companies, 1997-2003**

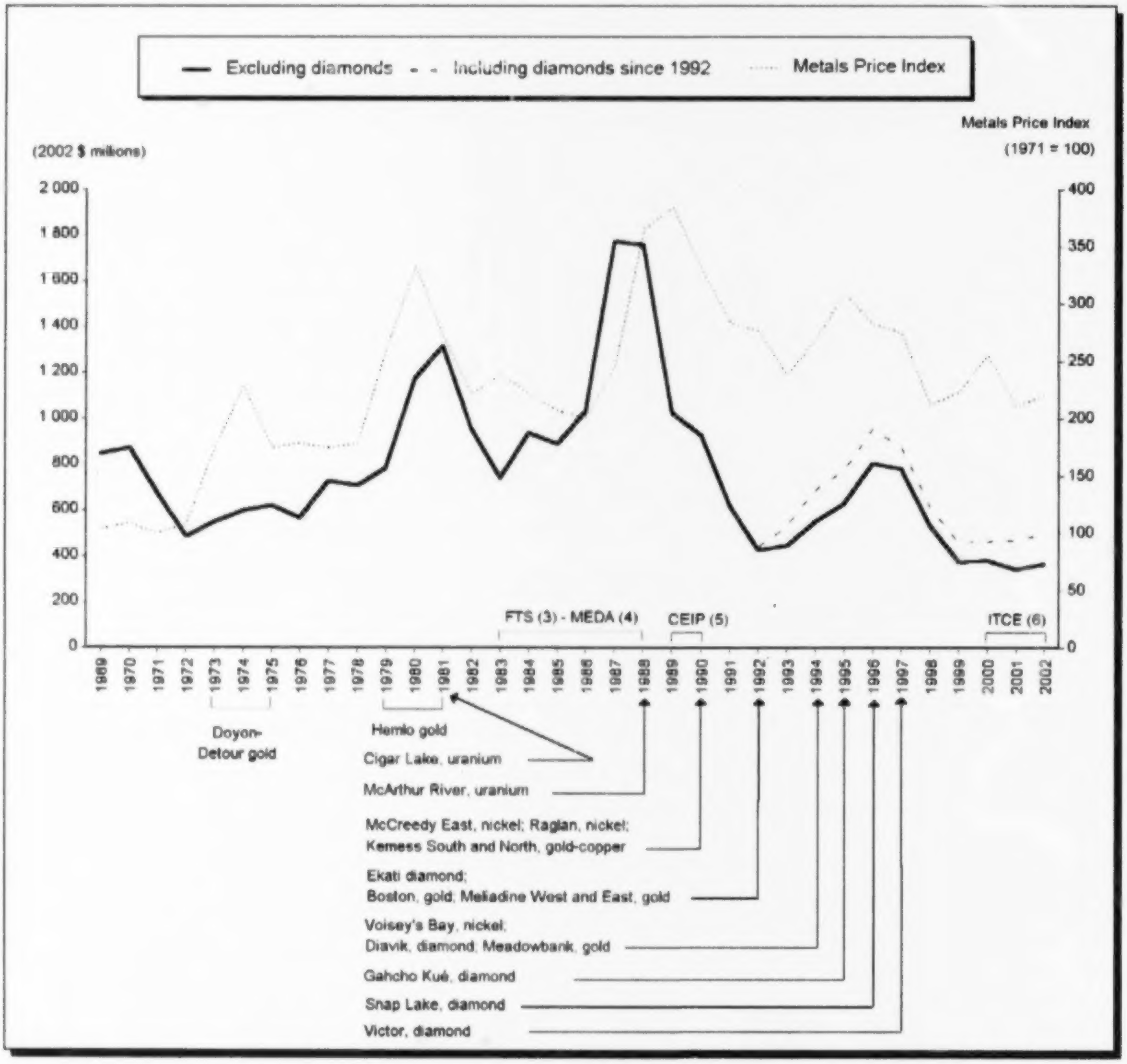


Source: Natural Resources Canada, from a federal-provincial territorial survey of mining and exploration companies.

(rsi) Revised spending intentions.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs.

Figure 2c
Exploration Plus Deposit Appraisal Expenditures, (1) Field and Overhead (2) Costs, Comparing Metals Price Index, Some Major Discoveries, and Federal Incentive Measures, 1969-2002



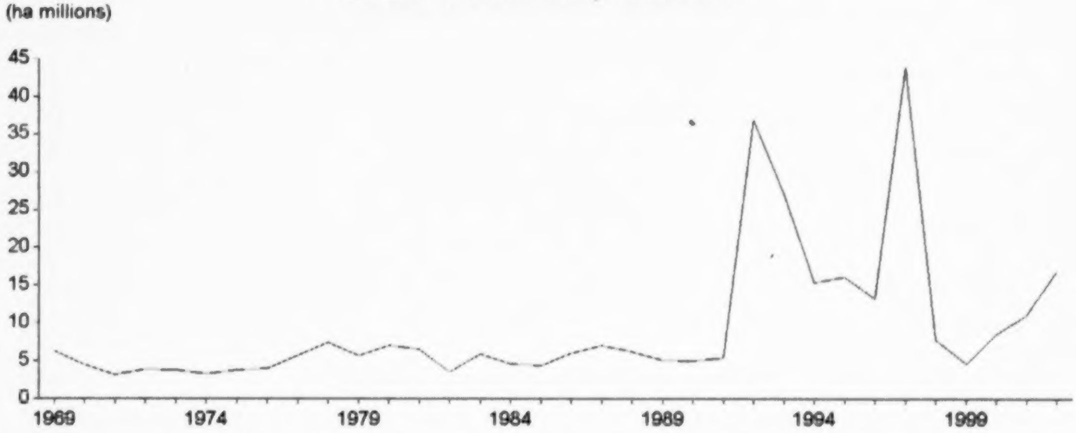
Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial/territorial survey of mining and exploration companies.

(1) Includes on-mine-site plus off-mine-site activities. (2) Overhead costs include mineral leases, claims and property taxes, and project-related head office expenditures. (3) FTS: Flow-through shares. (4) MEDA: Mining Exploration Depletion Allowance. (5) CEIP: Canadian Exploration Incentive Program. (6) ITCE: Investment Tax Credit for Exploration.

Notes: FTS program is continuous since 1983. Total exploration expenditures for 1975-81 are overstated by an average of about 17% relative to earlier and later years because of changes to the methodology used by Statistics Canada over the years. Expenditures for 1997 to 2002 include both exploration plus deposit appraisal as per new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were reported under exploration (broadly speaking).

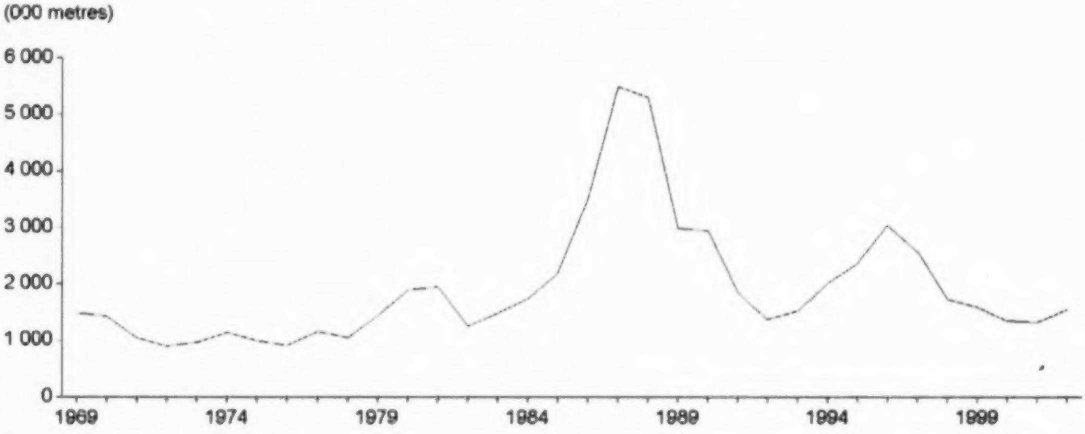
Figures 3a and 3b
Selected Measures of Exploration Activity

Figure 3a. Area of New Mineral Claims Staked or Recorded, 1969-2002



Source: Information obtained and compiled annually by Natural Resources Canada from provincial and territorial mining recorders.

Figure 3b. Surface Diamond Drilling, 1969-2002
(all minerals except oil and gas)

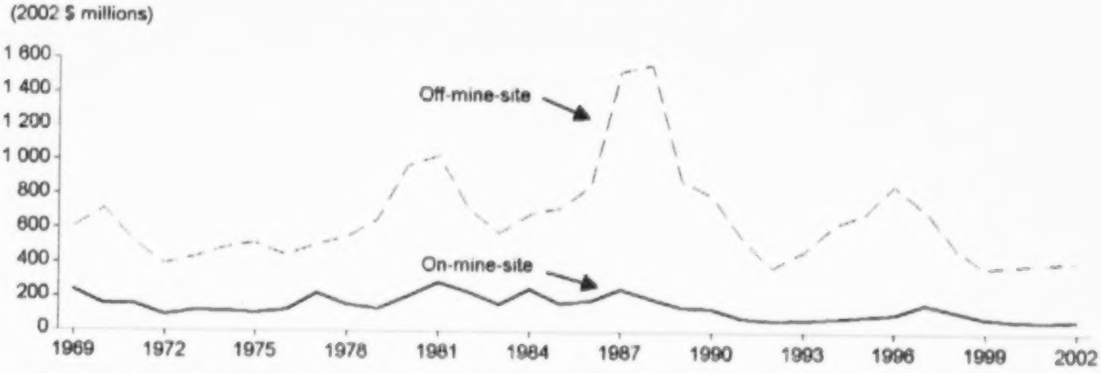


Source: 1969-84, Statistics Canada (cat no. 26-201); 1985-2002, from a federal-provincial territorial survey of mining and exploration companies.

Note: Data for 1969-84 include surface diamond drilling for the entire mineral development cycle. Data for 1985-2002 include surface diamond drilling in the exploration and deposit appraisal work phases only.

Figures 3c and 3d
Selected Measures of Exploration Activity

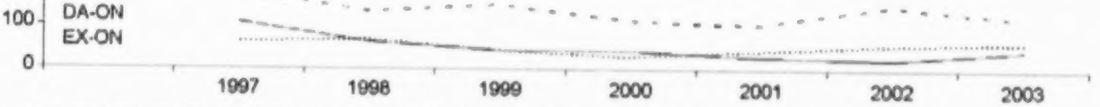
Figure 3c. Exploration Plus Deposit Appraisal, Field Work Plus Overhead Expenditures, 1969-2002
(all minerals except oil and gas)



Sources: 1969-84, Statistics Canada, Exploration, Development and Capital Expenditures for Petroleum and Natural Gas Wells, Intentions (cat. no. 61-216); 1985-2002, from a federal-provincial/territorial survey of mining and exploration companies.

Notes: Adjusted to 2002 dollars using Gross Domestic Product deflator series. These expenditures do not include expenditures for oil and gas exploration. Expenditures for 1997-2002 include exploration plus deposit appraisal as per new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were under exploration (broadly speaking). Off-mine-site and on-mine-site overhead expenditures for 1969-88 were estimated based on an average from the years 1989-96.

Figure 3d. Exploration and Deposit Appraisal Expenditures, (1) On- and Off-Mine-Site, 1997-2003



Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.

EX-OFF: Exploration off-mine-site. DA-OFF: Deposit appraisal off-mine-site.

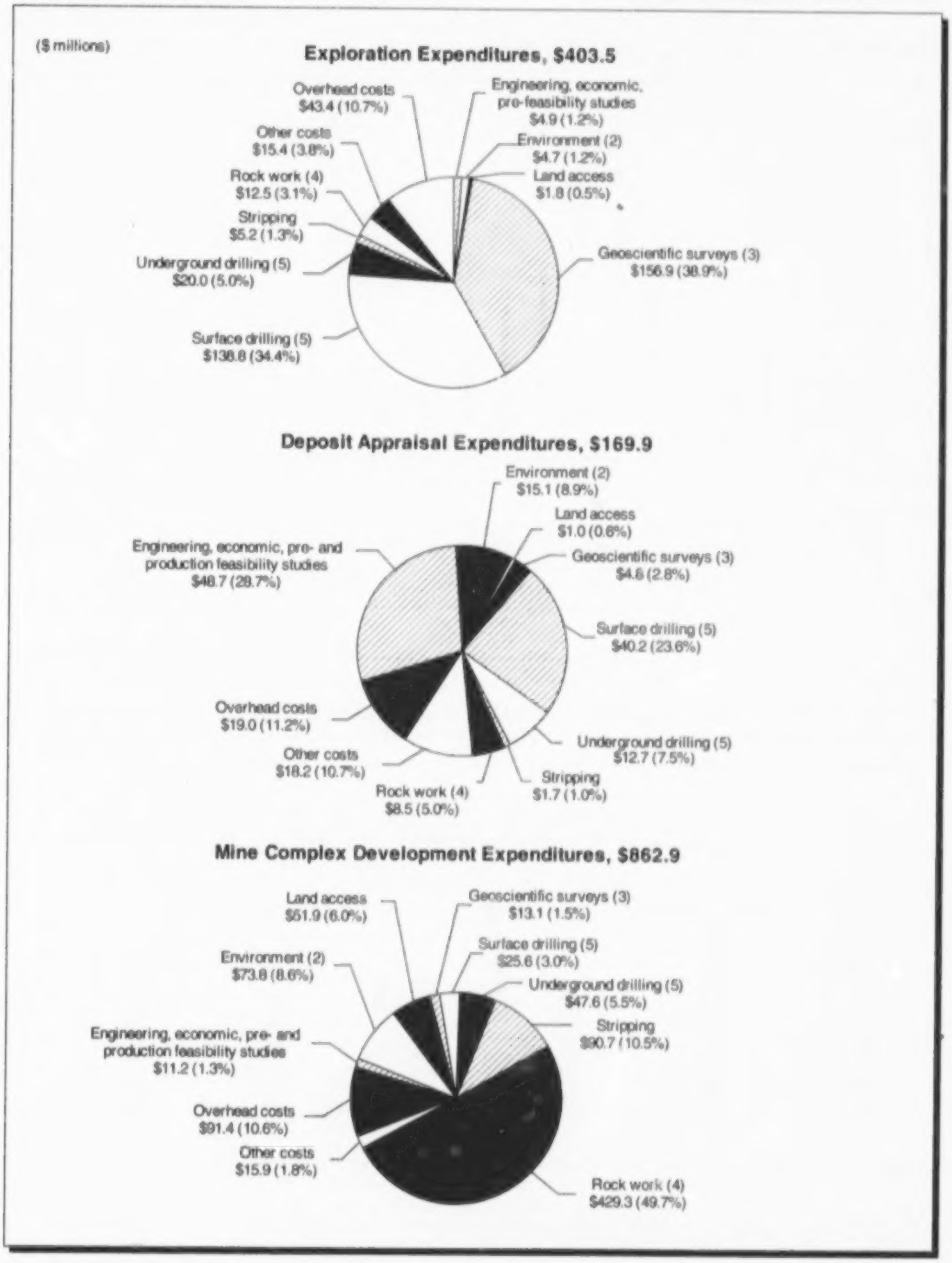
EX-ON: Exploration on-mine-site. DA-ON: Deposit appraisal on-mine-site.

(1) Includes field work, overhead, engineering, economic, pre- or production feasibility studies, environment and land access costs.

Note: Data for 2003 are revised spending intentions.

Figure 4

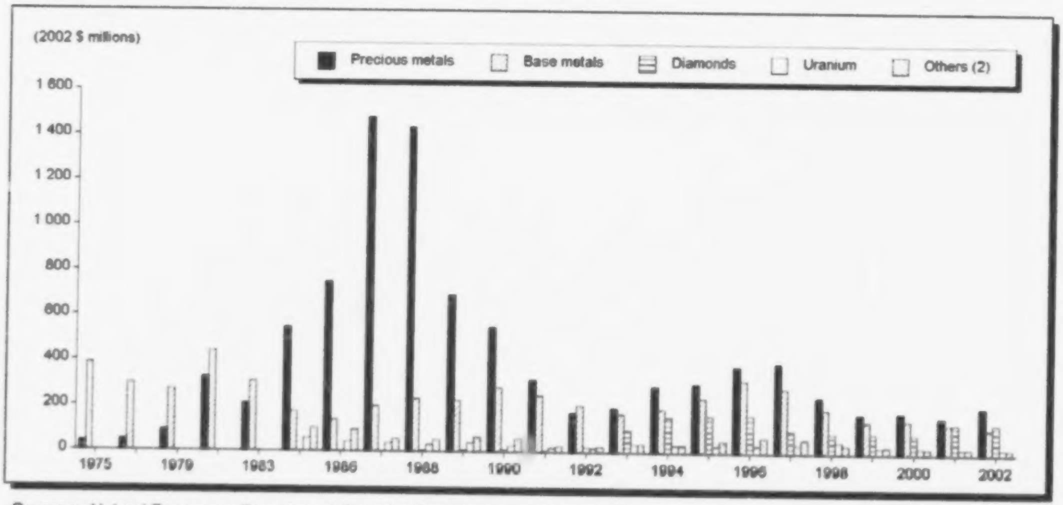
Exploration, Deposit Appraisal and Mine Complex Development Expenditures, (1) by Type of Activity, 2002



Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.

(1) Includes on-mine-site plus off-mine-site activities. (2) Environment includes characterization, permitting, protection, monitoring and restoration. (3) Geoscientific surveys include geology, geochemistry, ground geophysics and airborne geophysics. (4) Rock work activity includes shaft work, drifts, cross-cuts, raises, declines, rock sampling and dewatering costs. (5) Drilling includes diamond and other types of drilling.

Figure 5a
Exploration Plus Deposit Appraisal Expenditures, (1) Field and Overhead Costs, by Mineral Commodity, 1975-2002

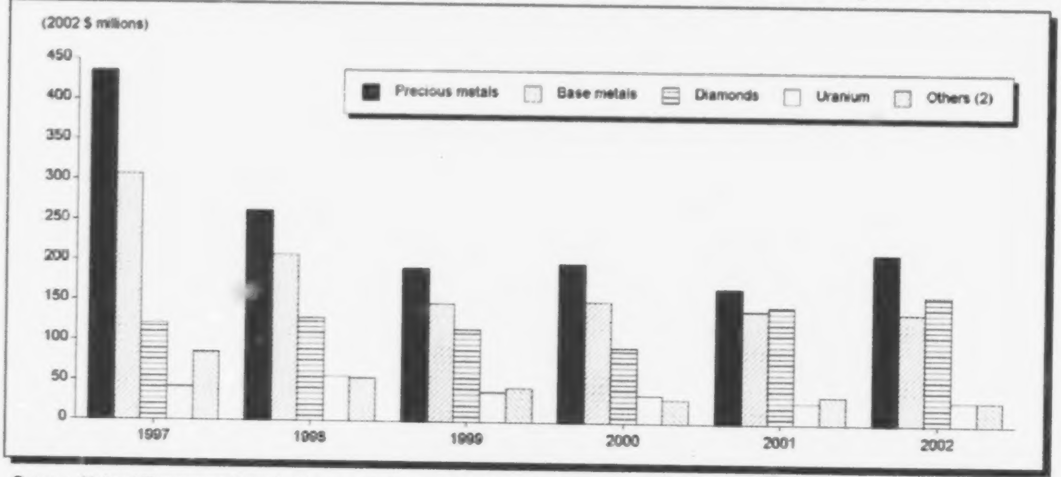


Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial/territorial survey of mining and exploration companies.

(1) Includes on-mine-site plus off-mine-site activities; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were under exploration (broadly speaking). (2) Others include coal, iron, other metals, nonmetals and unspecified mineral commodities where applicable.

Note: Data have not been compiled for 1976, 1978, 1980, 1982 and 1984.

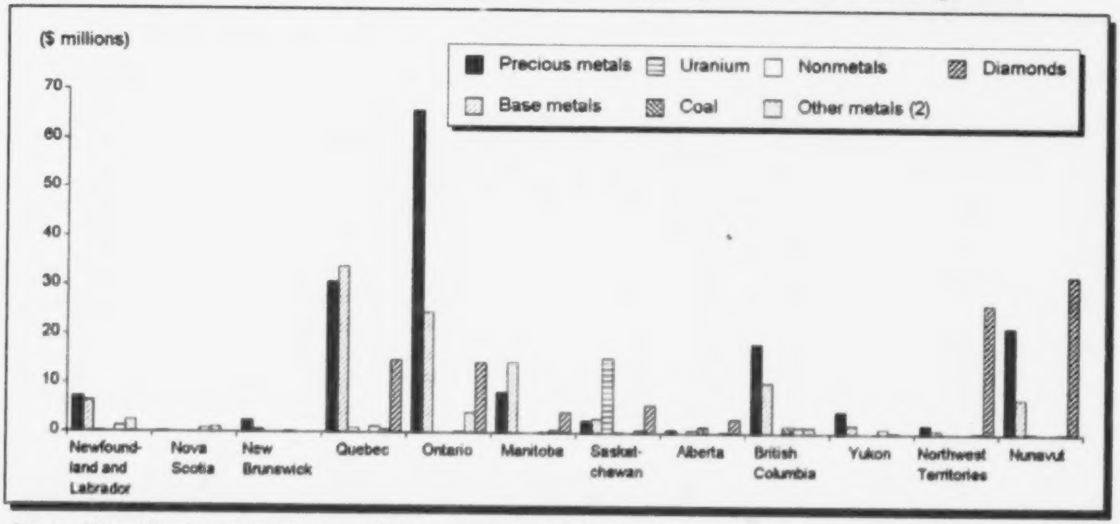
Figure 5b
Exploration Plus Deposit Appraisal Expenditures, (1) by Mineral Commodity, 1997-2002



Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.

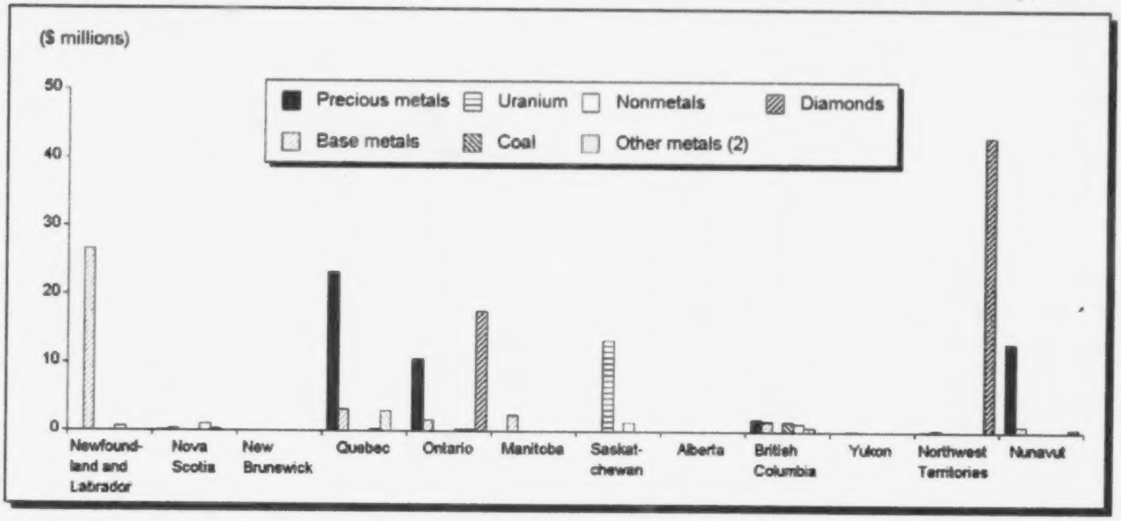
(1) Includes on-mine-site plus off-mine-site activities for field work, overhead, engineering, economic pre- or production feasibility studies, environment and land access costs. (2) Others include coal, iron, other metals, nonmetals and unspecified mineral commodities where applicable.

Figure 6a
Exploration Expenditures (1) **by Province and Territory, by Mineral Commodity, 2002**



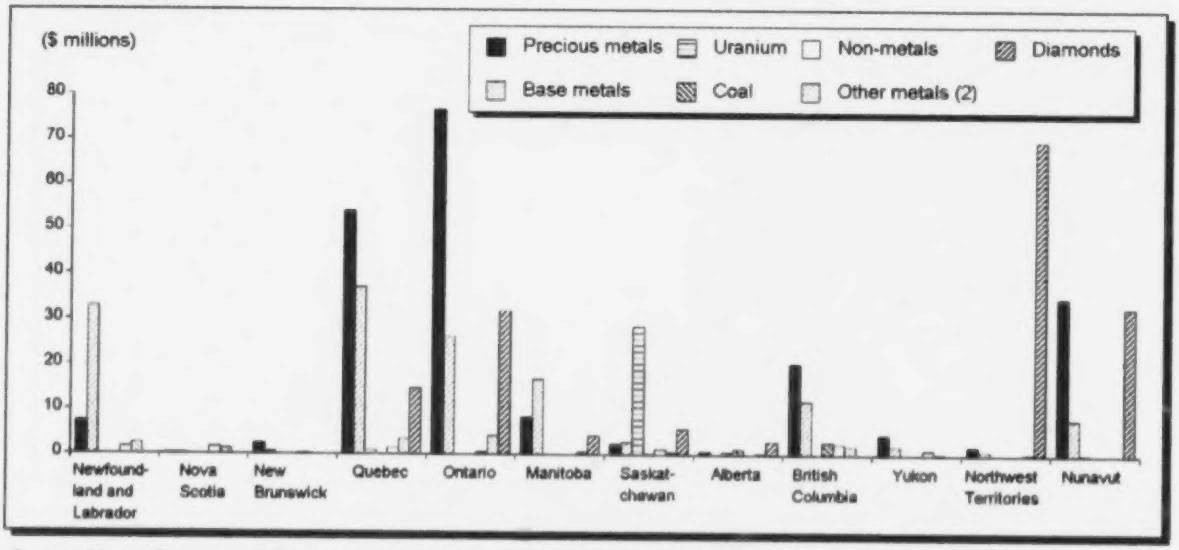
Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access costs. (2) Includes ferrous metals.

Figure 6b
Deposit Appraisal Expenditures (1) **by Province and Territory, by Mineral Commodity, 2002**



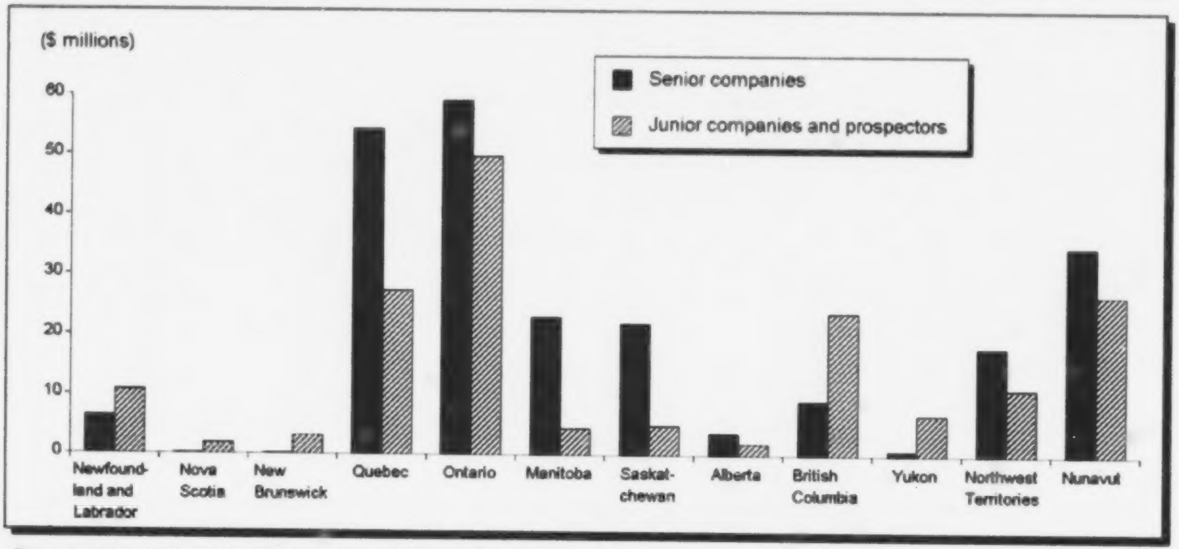
Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs. (2) Includes ferrous metals.

Figure 6c
Exploration Plus Deposit Appraisal Expenditures (1) by Province and Territory, by Mineral Commodity, 2002



Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs. (2) Includes ferrous metals.

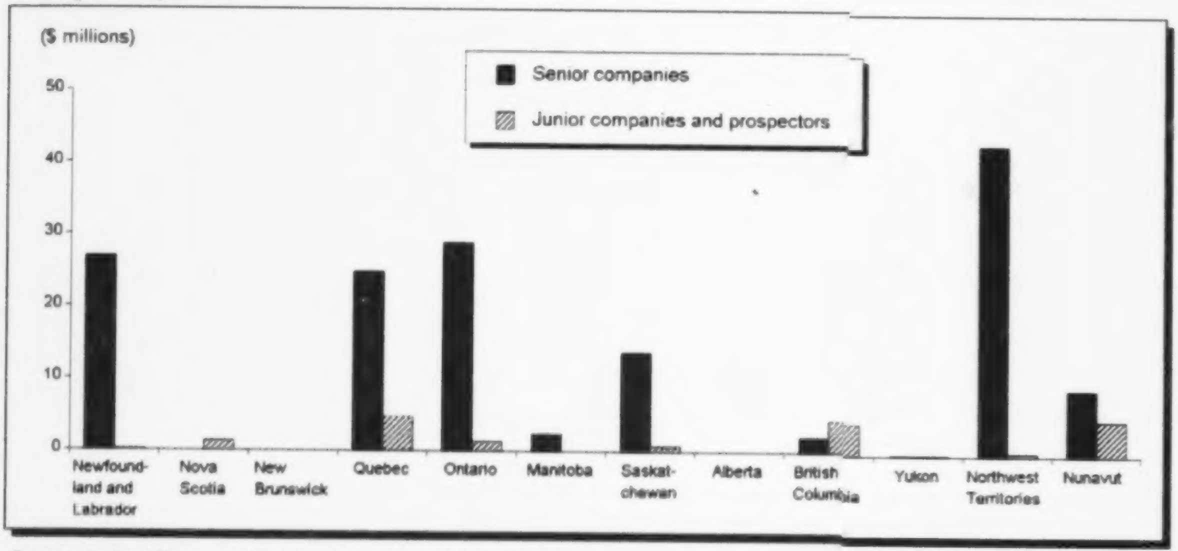
Figure 7a
Exploration Expenditures (1) by Province and Territory, by Junior and Senior Companies, 2002



Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access costs.

Figure 7b

Deposit Appraisal Expenditures (1) by Province and Territory, by Junior and Senior Companies, 2002

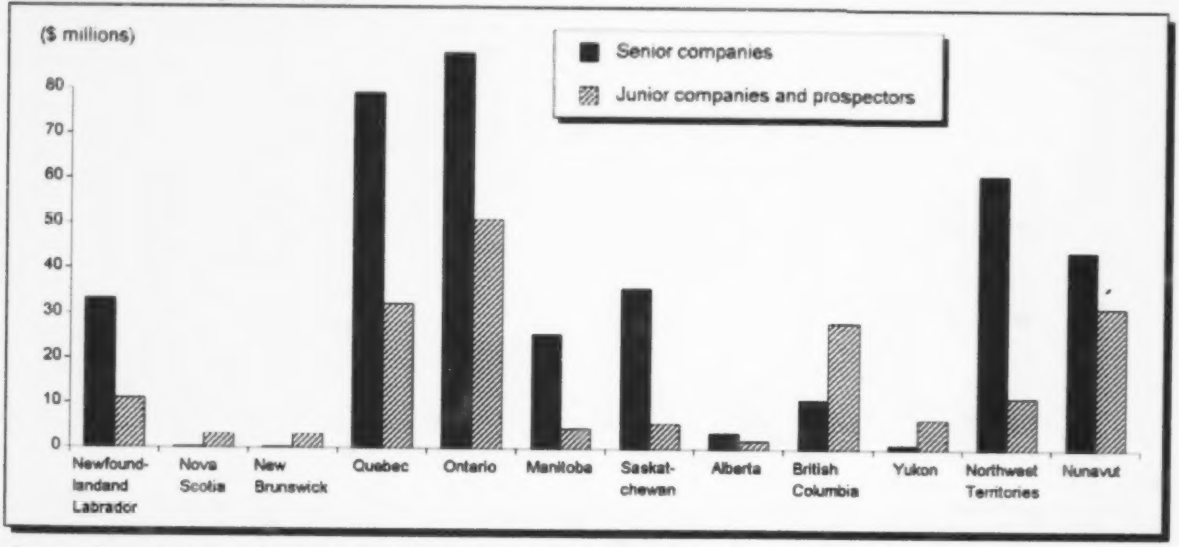


Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs.

Figure 7c

Exploration and Deposit Appraisal Expenditures (1) by Province and Territory, by Junior and Senior Companies, 2002

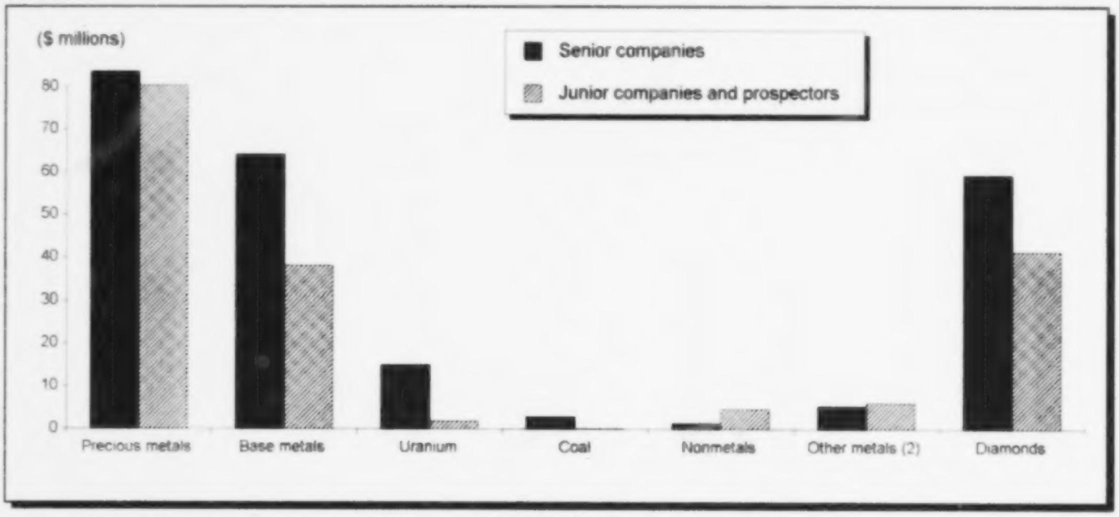


Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs.

Figure 8a

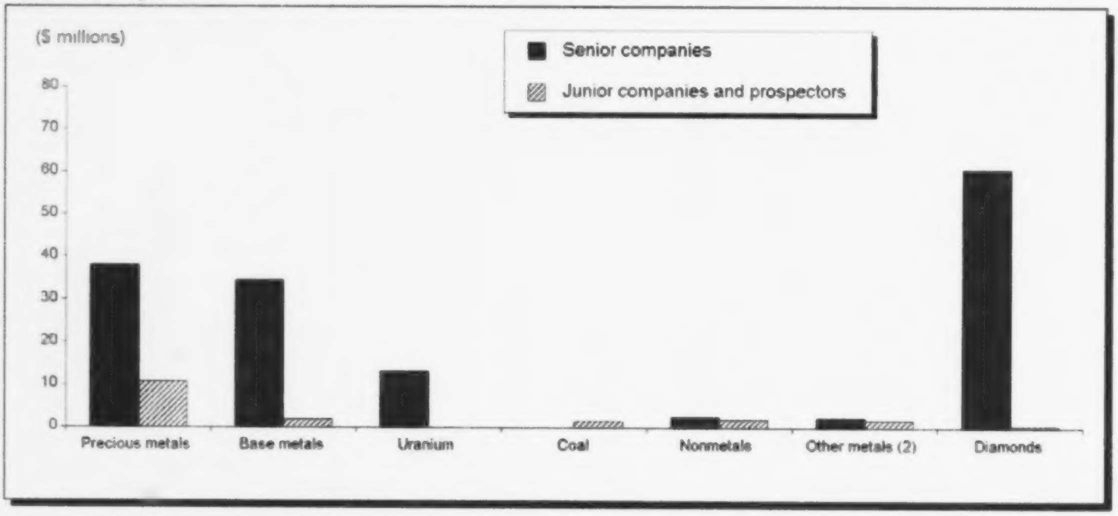
Exploration Expenditures, (1) by Junior and Senior Companies and by Mineral Commodity, 2002



Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access costs. (2) Includes ferrous metals.

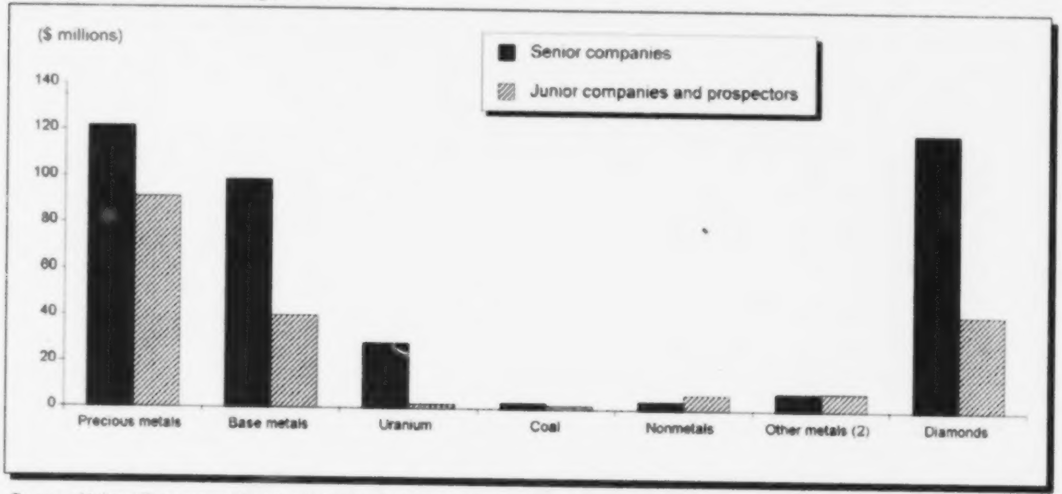
Figure 8b

Deposit Appraisal Expenditures, (1) by Junior and Senior Companies and by Mineral Commodity, 2002



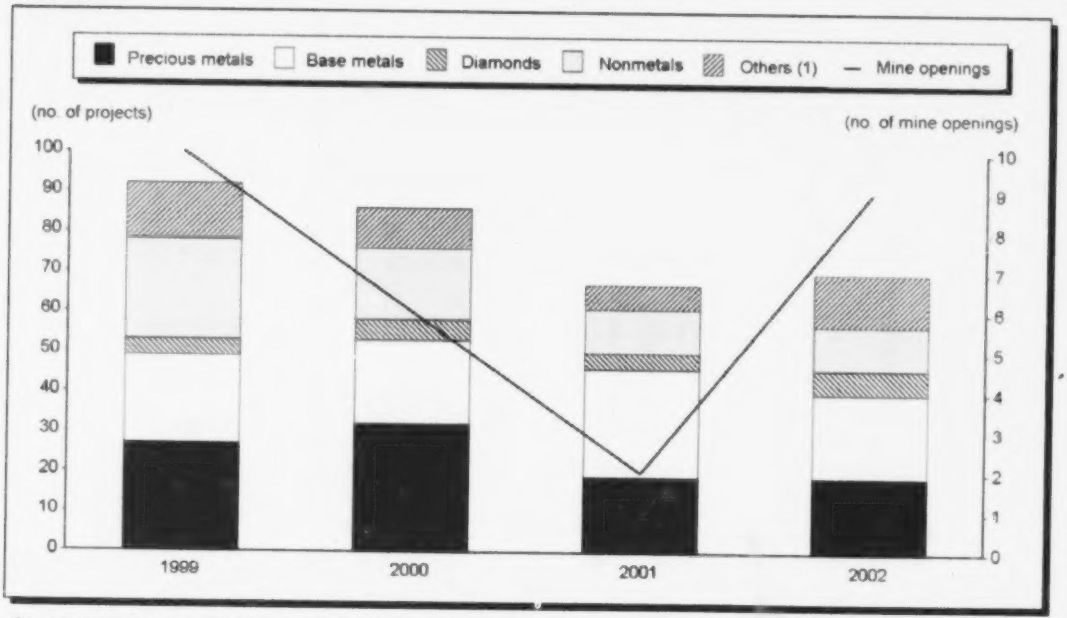
Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs. (2) Includes ferrous metals.

Figure 8c
Exploration Plus Deposit Appraisal Expenditures, (1) by Junior and Senior Companies and by Mineral Commodity, 2002



Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs. (2) Includes ferrous metals.

Figure 9
Deposit Appraisal Off-Mine-Site, Number of Projects by Commodity, and Mine Openings, 1999-2002



Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes iron, uranium, other metals, coal, nonmetals and unspecified mineral commodities where applicable.
Note: In 2002, the number of diamond projects includes two separate projects at Ekati.

TABLE 1. EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT ACTIVITY, ON- AND OFF-MINE-SITE, 2001-03

Expenditure Category by Work Phase	2001					2002					2003(rsi)				
	Off-Mine-Site		On-Mine-Site		Total	Off-Mine-Site		On-Mine-Site		Total	Off-Mine-Site		On-Mine-Site		Total
	($ millions)	(%)	($ millions)	(%)	($ millions)	($ millions)	(%)	($ millions)	(%)	($ millions)	($ millions)	(%)	($ millions)	(%)	($ millions)
EXPLORATION															
Field work and overhead	332.2	88.9	41.6	11.1	373.9	339.0	86.5	53.1	13.5	392.1	. .	. .	. .	. .	. .
Engineering studies	0.9	98.2	. . .	1.8	1.0	4.1	89.4	0.5	10.6	4.6	. .	. .	. .	. .	. .
Economic studies	0.2	100.0	–	–	0.2	0.2	99.5	. . .	0.5	0.2	. .	. .	. .	. .	. .
Pre-feasibility studies	0.3	59.7	0.2	40.3	0.5	0.1	100.0	–	–	0.1	. .	. .	. .	. .	. .
Environment	2.7	86.5	0.4	13.5	3.1	1.9	39.7	2.9	60.3	4.7	. .	. .	. .	. .	. .
Land access	2.6	98.9	. . .	1.1	2.6	1.8	100.0	–	–	1.8	. .	. .	. .	. .	. .
Subtotal	338.9	88.9	42.3	11.1	381.2	347.1	86.0	56.4	14.0	403.5	459.3	88.1	62.2	11.9	521.5
Capital (1)	7.6	100.0	–	–	7.6	0.6	6.3	9.6	93.7	10.3	2.8	20.9	10.5	79.1	13.3
Repair and maintenance (1)	1.2	71.5	0.5	28.5	1.7	0.5	5.3	8.9	94.7	9.4	. .	. .	. .	. .	. .
Total	347.6	89.0	42.8	11.0	390.4	348.3	82.3	74.9	17.7	423.2	462.1	86.4	72.7	13.6	534.8
DEPOSIT APPRAISAL															
Field work and overhead	69.6	72.4	26.6	27.6	96.2	81.9	77.9	23.2	22.1	105.1	. .	. .	. .	. .	. .
Engineering studies	15.9	89.7	1.8	10.3	17.7	24.0	97.9	0.5	2.1	24.5	. .	. .	. .	. .	. .
Economic studies	4.7	96.6	0.2	3.4	4.8	1.0	100.0	–	–	1.0	. .	. .	. .	. .	. .
Pre- or production feasibility studies	4.3	94.2	0.3	5.8	4.6	23.0	99.4	0.1	0.6	23.2	. .	. .	. .	. .	. .
Environment	4.9	93.5	0.3	6.5	5.2	15.0	99.9	. . .	0.1	15.1	. .	. .	. .	. .	. .
Land access	3.2	100.0	–	–	3.2	1.0	100.0	–	–	1.0	. .	. .	. .	. .	. .
Subtotal	102.5	77.8	29.2	22.2	131.7	146.0	86.0	23.9	14.0	169.9	117.6	72.2	45.2	27.8	162.8
Capital (1)	1.6	85.2	0.3	14.8	1.9	20.9	99.1	0.2	0.9	21.1	4.8	76.7	1.5	23.3	6.3
Repair and maintenance (1)	2.1	100.0	–	–	2.1	2.7	62.6	1.6	37.4	4.3	. .	. .	. .	. .	. .
Total	106.2	78.3	29.5	21.7	135.7	169.6	86.9	25.7	13.1	195.3	122.4	72.9	46.6	27.6	169.1
EXPLORATION PLUS DEPOSIT APPRAISAL															
Field work and overhead	401.8	85.5	68.2	14.5	470.1	421.0	84.7	76.3	15.3	497.2	. .	. .	. .	. .	. .
Engineering studies	16.8	90.1	1.8	9.9	18.7	28.1	96.6	1.0	3.4	29.1	. .	. .	. .	. .	. .
Economic studies	4.8	96.7	0.2	3.3	5.0	1.2	99.9	. . .	0.1	1.2	. .	. .	. .	. .	. .
Pre- or production feasibility studies	4.6	91.0	0.5	9.0	5.0	23.1	99.4	0.1	0.6	23.3	. .	. .	. .	. .	. .
Environment	7.6	90.9	0.8	9.1	8.3	16.9	85.5	2.9	14.5	19.8	. .	. .	. .	. .	. .
Land access	5.8	99.5	. . .	0.5	5.8	2.8	100.0	–	–	2.8	. .	. .	. .	. .	. .
Subtotal	441.4	86.1	71.5	13.9	512.9	493.1	86.0	80.3	14.0	573.4	576.9	84.3	107.3	15.7	684.2
Capital (1)	9.2	97.0	0.3	3.0	9.5	21.6	68.7	9.8	31.3	31.4	7.6	38.8	12.0	61.2	19.6
Repair and maintenance (1)	3.3	87.4	0.5	12.6	3.7	3.2	23.5	10.5	76.5	13.7	. .	. .	. .	. .	. .
Total	453.9	86.3	72.2	13.7	526.1	517.9	83.7	100.6	16.3	618.5	584.5	123.1	119.3	17.0	703.8
MINE COMPLEX DEVELOPMENT															
Field work and overhead	n.a.	n.a.	742.4	100.0	742.4	n.a.	n.a.	726.0	100.0	726.0	n.a.	n.a.	. .	. .	. .
Engineering studies	n.a.	n.a.	23.4	100.0	23.4	n.a.	n.a.	10.2	100.0	10.2	n.a.	n.a.	. .	. .	. .
Economic studies	n.a.	n.a.	0.1	100.0	0.1	n.a.	n.a.	0.3	100.0	0.3	n.a.	n.a.	. .	. .	. .
Pre- or production feasibility studies	n.a.	n.a.	0.9	100.0	0.9	n.a.	n.a.	0.7	100.0	0.7	n.a.	n.a.	. .	. .	. .
Environment	n.a.	n.a.	57.9	100.0	57.9	n.a.	n.a.	73.8	100.0	73.8	n.a.	n.a.	. .	. .	. .
Land access	n.a.	n.a.	4.8	100.0	4.8	n.a.	n.a.	51.9	100.0	51.9	n.a.	n.a.	. .	. .	. .
Subtotal	n.a.	n.a.	829.5	100.0	829.5	n.a.	n.a.	862.9	100.0	862.9	n.a.	n.a.	751.2	100.0	751.2
Capital (1)	n.a.	n.a.	1 766.1	100.0	1 766.1	n.a.	n.a.	1 260.1	100.0	1 260.1	n.a.	n.a.	1 189.5	100.0	1 189.5
Repair and maintenance (1)	n.a.	n.a.	1 524.0	100.0	1 524.0	n.a.	n.a.	1 474.6	100.0	1 474.6	n.a.	n.a.	. .	. .	. .
Total	n.a.	n.a.	4 119.5	100.0	4 119.5	n.a.	n.a.	3 597.6	100.0	3 597.6	n.a.	n.a.	1 940.7	100.0	1 940.7
Grand total	453.9	9.8	4 191.7	90.2	4 645.6	517.9	12.3	3 698.2	87.7	4 216.1	584.5	22.1	2 060.1	77.9	2 644.6

Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; n.a. Not applicable; . . Not available; . . . Amount too small to be expressed; (rsi) Data for 2003 are revised spending intentions.
(1) Includes construction, and machinery and equipment expenditures, as well as related environmental protection and restoration expenditures.
Notes: Totals for 2003 revised spending intentions are incomplete; they do not include any repair and maintenance expenditures. Numbers may not add to totals due to rounding.

TABLE 2. SUMMARY OF ENVIRONMENT EXPENDITURES FOR EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT, 2001 AND 2002

Expenditure Category	Exploration				Deposit Appraisal				Exploration Plus Deposit Appraisal				Mine Complex Development				Total			
	2001		2002		2001		2002		2001		2002		2001		2002		2001		2002	
	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
Environment																				
Characterization	491	15.7	539	11.2	1 990	38.2	4 064	27.0	2 481	29.8	4 603	23.1	4 372	3.7	1 885	1.2	6 853	5.4	6 488	3.6
Permits	337	10.8	321	6.6	2 080	40.0	3 941	26.2	2 417	29.0	4 262	21.4	2 374	2.0	1 394	0.9	4 791	3.8	5 657	3.2
Protection	251	8.0	553	11.4	1 104	21.2	7 011	46.6	1 356	16.3	7 564	38.0	25 311	21.6	21 517	13.5	26 667	21.2	29 081	16.3
Restoration	2 055	65.6	3 319	68.7	30	0.6	35	0.2	2 085	25.0	3 354	16.9	25 814	22.0	48 999	30.8	27 899	22.2	52 353	29.3
Subtotal	3 134		4 731		5 204		15 052		8 338		19 783		57 872		73 796		66 210		93 579	
Capital, share of environment	–	–	–	–	–	–	–	–	–	–	–	–	26 324	22.4	56 124	35.3	26 324	20.9	56 124	31.4
Repair and maintenance, share of environment	–	–	100	2.1	–	–	3	. . .	–	–	103	0.5	33 239	28.3	29 012	18.3	33 239	26.4	29 115	16.3
Total environment	3 134	100.0	4 831	100.0	5 204	100.0	15 055	100.0	8 338	100.0	19 886	100.0	117 434	100.0	158 931	100.0	125 773	100.0	178 817	100.0
Total environment as a percentage of work phase total (1)		0.8		1.1		3.8		7.7		1.6		3.2		2.9		4.5		2.7		4.3

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.

– Nil; . . . Amount too small to be expressed.

(1) Work phase total refers to Table 1.

Note: Numbers may not add to totals due to rounding.

TABLE 3a. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,(1) FIELD WORK PLUS OVERHEAD, BY JUNIOR AND SENIOR COMPANIES, 1969-2002

	Current Dollars				Constant 2002 Dollars			
	Share of Total			% of Total	Share of Total			% of Total
Year	Junior	Senior	Total	Junior	Junior	Senior	Total	Junior
	($ millions)			(%)	($ millions)			(%)
1969	44.4	130.5	174.9	25.4	215.0	631.9	846.9	25.4
1970	39.9	147.2	187.1	21.3	185.7	685.0	870.7	21.3
1971	24.5	127.5	152.0	16.1	108.4	564.0	672.4	16.1
1972	18.3	97.4	115.7	15.8	76.5	407.4	484.0	15.8
1973	22.5	121.6	144.1	15.6	85.8	463.5	549.3	15.6
1974	21.8	158.5	180.3	12.1	72.3	525.9	598.2	12.1
1975	19.5	187.8	207.3	9.4	58.4	562.4	620.7	9.4
1976	13.9	192.9	206.8	6.7	38.0	527.7	565.7	6.7
1977	12.5	271.0	283.5	4.4	32.0	693.6	725.6	4.4
1978	19.8	275.0	294.8	6.7	47.5	659.9	707.4	6.7
1979	29.4	329.5	358.9	8.2	64.2	719.9	784.2	8.2
1980	60.2	530.0	590.2	10.2	119.4	1 051.2	1 170.6	10.2
1981	83.0	651.2	734.2	11.3	148.5	1 164.8	1 313.3	11.3
1982	73.8	502.5	576.3	12.8	121.9	829.8	951.6	12.8
1983	71.2	400.6	471.8	15.1	111.4	626.8	738.3	15.1
1984	146.9	470.4	617.3	23.8	222.7	713.2	936.0	23.8
1985	181.1	424.7	605.8	29.9	266.0	623.7	889.7	29.9
1986	348.6	374.7	723.3	48.2	497.1	534.2	1 031.2	48.2
1987	668.2	631.8	1 300.0	51.4	911.6	861.9	1 773.5	51.4
1988	668.3	681.8	1 350.1	49.5	871.9	889.5	1 761.4	49.5
1989	272.6	555.3	827.9	32.9	340.4	693.3	1 033.7	32.9
1990	241.0	533.7	774.7	31.1	291.4	645.4	936.8	31.1
1991	116.1	415.6	531.8	21.8	136.4	488.3	624.8	21.8
1992	79.9	305.4	385.3	20.7	92.7	354.2	446.8	20.7
1993	142.7	334.5	477.3	29.9	163.2	382.6	545.8	29.9
1994	195.8	432.3	628.1	31.2	221.3	488.7	710.0	31.2
1995	213.4	504.2	717.6	29.7	236.0	557.6	793.6	29.7
1996	314.7	580.0	894.8	35.2	342.4	631.1	973.5	35.2
1997	266.7	553.4	820.2	32.5	286.7	595.0	881.7	32.5
1998	155.9	420.0	575.9	27.1	168.3	453.3	621.6	27.1
1999	123.3	314.6	437.9	28.2	130.8	333.8	464.7	28.2
2000	142.3	315.8	458.1	31.1	145.1	322.1	467.2	31.1
2001	167.7	302.4	470.1	35.7	169.3	305.2	474.5	35.7
2002	179.0	318.2	497.2	36.0	179.0	318.2	497.2	36.0

Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial/territorial survey of mining and exploration companies.

(1) Includes on-mine-site plus off-mine-site activities.

Note: Up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were reported under exploration (broadly speaking).

TABLE 3b. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,(1) BY JUNIOR AND SENIOR COMPANIES, 1997-2003

	Current Dollars				Constant 2002 Dollars			
	Share of Total			% of Total	Share of Total			% of Total
Year	Junior	Senior	Total	Junior	Junior	Senior	Total	Junior
	($ millions)			(%)	($ millions)			(%)
1997	298.0	623.0	921.0	32.4	320.3	669.7	990.0	32.4
1998	170.5	485.4	655.9	26.0	184.1	523.9	708.0	26.0
1999	141.4	362.9	504.3	28.0	150.1	385.1	535.2	28.0
2000	156.0	340.7	496.7	31.4	159.1	347.5	506.5	31.4
2001	177.7	335.1	512.9	34.7	179.4	338.3	517.7	34.7
2002	190.8	382.6	573.4	33.3	190.8	382.6	573.4	33.3
2003 (rsi)	280.7	403.5	684.2	41.0	280.7	403.5	684.2	41.0

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.

(rsi) Revised spending intentions.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs.

TABLE 3c. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES,[1] ON- AND OFF-MINE-SITE, BY JUNIOR AND SENIOR COMPANIES, 1997-2003

	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal		Exploration Plus Deposit Appraisal
	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On- and Off-Mine-Site
				($000)			
1997							
Junior	n.a.	233 231	n.a.	64 730	n.a.	297 961	297 961
Senior	62 383	338 796	105 608	116 222	167 991	455 018	623 009
Total	62 383	572 027	105 608	180 951	167 991	752 979	920 970
1998							
Junior	n.a.	144 970	n.a.	25 573	n.a.	170 544	170 544
Senior	67 875	249 959	61 535	106 018	129 411	355 977	485 387
Total	67 875	394 929	61 535	131 591	129 411	526 520	655 931
1999							
Junior	n.a.	92 923	n.a.	48 498	n.a.	141 421	141 421
Senior	44 471	177 265	42 302	98 889	86 773	276 154	362 927
Total	44 471	270 188	42 302	147 386	86 773	417 575	504 348
2000							
Junior	n.a.	127 853	n.a.	28 109	n.a.	155 962	155 962
Senior	30 743	183 929	42 273	83 744	73 016	267 672	340 689
Total	30 743	311 782	42 273	111 853	73 016	423 635	496 651
2001							
Junior	n.a.	157 913	n.a.	19 820	n.a.	177 733	177 733
Senior	42 297	180 963	29 173	82 704	71 469	263 667	335 136
Total	42 297	338 876	29 173	102 524	71 469	441 400	512 869
2002							
Junior	n.a.	172 402	n.a.	18 391	n.a.	190 793	190 793
Senior	56 406	174 735	23 863	127 621	80 272	302 356	382 628
Total	56 408	347 137	23 863	146 012	80 272	493 149	573 421
2003 (rsi)							
Junior	n.a.	246 288	n.a.	34 406	n.a.	280 694	280 694
Senior	62 165	213 010	45 184	83 173	107 349	296 183	403 532
Total	62 165	459 298	45 184	117 580	107 349	576 877	684 227

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
n.a. Not applicable; (rsi) Revised spending intentions.
(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs.

TABLE 4. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,(1) BY RANGE OF EXPENDITURES AND BY JUNIOR AND SENIOR COMPANIES, 2000-2003

Range of Expenditures	Junior			Senior			Total		
	Companies	Expenditures	Percentage of Total Expenditures	Companies	Expenditures	Percentage of Total Expenditures	Companies	Expenditures	Percentage of Total Expenditures
($)	(number)	($000)	(%)	(number)	($000)	(%)	(number)	($000)	(%)
2000									
>10 million	1	16 697	10.7	8	160 666	47.2	9	177 363	35.7
5 million-10 million	1	5 678	3.6	16	112 933	33.1	17	118 611	23.9
1 million-5 million	34	67 998	43.6	26	53 380	15.7	60	121 378	24.4
500 000-1 million	35	24 328	15.6	12	8 254	2.4	47	32 582	6.6
200 000-500 000	69	22 736	14.6	7	2 184	0.6	76	24 920	5.0
100 000-200 000	58	8 121	5.2	14	2 080	0.6	72	10 201	2.1
50 000-100 000	48	3 368	2.2	12	887	0.3	60	4 255	0.9
1-50 000	141	2 522	1.6	22	304	0.1	163	2 826	0.6
Subtotal	387	151 448	97.1	117	340 689	100.0	504	492 137	99.1
Prospectors (2)	37	4 514	2.9	–	–	–	37	4 514	0.9
Total 2000	424	155 962	100.0	117	340 689	100.0	541	496 651	100.0
2001									
>10 million	1	14 336	8.1	11	222 869	66.5	12	237 205	46.3
5 million-10 million	4	28 571	16.1	9	60 863	18.2	13	89 434	17.4
1 million-5 million	34	62 821	35.3	19	37 525	11.2	53	100 346	19.6
500 000-1 million	42	28 921	16.3	9	6 494	1.9	51	35 416	6.9
200 000-500 000	69	22 237	12.5	9	3 046	0.9	78	25 284	4.9
100 000-200 000	71	10 144	5.7	24	3 629	1.1	95	13 773	2.7
50 000-100 000	57	4 027	2.3	4	304	0.1	61	4 331	0.8
1-50 000	122	2 052	1.2	25	405	0.1	147	2 458	0.5
Subtotal	400	173 110	97.4	110	335 136	100.0	510	508 246	99.1
Prospectors (2)	43	4 623	2.6	–	–	–	43	4 623	0.9
Total 2001	443	177 733	100.0	110	335 136	100.0	553	512 869	100.0
2002									
>10 million	–	–	–	12	256 148	66.9	12	256 148	44.7
5 million-10 million	6	37 258	19.5	8	56 659	14.8	14	93 917	16.4
1 million-5 million	40	69 855	36.6	23	61 252	16.0	63	131 107	22.9
500 000-1 million	48	32 201	16.9	4	2 918	0.8	52	35 118	6.1
200 000-500 000	89	28 979	15.2	10	3 448	0.9	99	32 427	5.7
100 000-200 000	76	10 886	5.7	9	1 426	0.4	85	12 312	2.1
50 000-100 000	60	3 939	2.1	6	448	0.1	66	4 387	0.8
1-50 000	144	2 828	1.5	21	329	0.1	165	3 157	0.6
Subtotal	463	185 946	97.5	93	382 628	100.0	556	568 573	99.2
Prospectors (2)	30	4 847	2.5	–	–	–	30	4 847	0.8
Total 2002	493	190 793	100.0	93	382 628	100.0	586	573 421	100.0
2003 (rsi)									
>10 million	1	10 500	3.7	14	282 369	70.0	15	292 869	42.8
5 million-10 million	5	29 360	10.5	8	54 007	13.4	13	83 367	12.2
1 million-5 million	71	140 794	50.2	24	56 800	14.1	95	197 594	28.9
500 000-1 million	74	49 063	17.5	7	4 824	1.2	81	53 887	7.9
200 000-500 000	112	32 849	11.7	12	3 481	0.9	124	36 330	5.3
100 000-200 000	64	8 701	3.1	7	909	0.2	71	9 611	1.4
50 000-100 000	42	2 556	0.9	9	609	0.2	51	3 165	0.5
1-50 000	111	1 884	0.7	24	533	0.1	135	2 417	0.4
Subtotal	480	275 708	98.2	105	403 532	100.0	585	679 240	99.3
Prospectors (2)	39	4 986	1.8	–	–	–	39	4 986	0.7
Total 2003 (rsi)	519	280 694	100.0	105	403 532	100.0	624	684 227	100.0

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.

– Nil; (rsi) Revised spending intentions.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs. (2) The number of prospectors is underestimated because it contains groups of prospectors.

Note: Numbers may not add to totals due to rounding.

TABLE 5. SUMMARY OF TOTAL DIAMOND EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] 1998-2002

Expenditure Category	1998	1999	2000	2001	2002
			($ millions)		
Field work and overhead	148.9	83.9	95.0	240.2	188.3
Engineering, economic and pre- or production feasibility studies, environment and land access	36.7	25.0	55.2	27.5	34.4
Capital (2)	155.9	13.3	226.3	531.4	459.7
Repair (2)	5.4	62.7	55.5	88.4	63.3
Total	347.1	185.0	432.1	887.4	745.7

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes construction, and machinery and equipment expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 6a. AREA[1] OF NEW MINERAL CLAIMS STAKED OR RECORDED IN CANADA AS A PERCENTAGE OF PREVIOUS YEAR, 1996-2002

Province/Territory	1996		1997		1998		1999		2000		2001		2002	
	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)
Newfoundland and Labrador	417 575	6.8	334 075	80.0	361 900	108.3	241 075	66.6	324 225	134.5	391 625	120.8	828 150	211.5
Nova Scotia	424 815	231.0	208 191	49.0	74 180	35.6	157 394	212.2	96 819	61.5	87 722	90.6	147 713	168.4
New Brunswick	93 760	155.1	53 760	57.3	40 000	74.4	28 336	70.8	49 344	174.1	35 712	72.4	33 888	94.9
Quebec	954 967	64.8	1 050 629	110.0	728 142	69.3	754 102	103.6	2 187 551	290.1	2 115 424	96.7	3 290 446	155.5
Ontario	903 488	135.1	855 584	94.7	577 632	67.5	604 096	104.6	874 896	144.8	981 904	112.2	813 424	82.8
Manitoba	325 452	48.6	386 243	118.7	475 634	123.1	801 550	168.5	1 759 381	219.5	1 054 106	59.9	1 287 997	122.2
Saskatchewan	469 040	137.6	950 253	202.6	680 048	71.6	(a) 161 083	23.7	523 440	325.0	558 131	106.6	339 490	60.8
Alberta	5 328 000	320.0	37 200 000	698.2	3 490 000	9.4	1 026 000	29.4	2 349 600	229.0	4 192 055	178.4	4 670 028	111.4
British Columbia	997 740	118.0	765 257	76.7	474 296	62.0	478 740	100.9	699 050	146.0	636 800	91.1	688 500	108.1
Yukon	(r) 415 256	(r) 147.0	(r) 196 457	(r) 47.3	(r) 113 057	(r) 57.5	(r) 146 419	(r) 129.5	(r) 53 413	(r) 36.5	(r) 40 644	(r) 76.1	81 872	201.4
Northwest Territories	2 956 017	77.0	1 953 191	66.1	827 615	42.4	563 378	(b) 68.1	891 419	158.2	626 177	70.2	1 099 888	175.7
Nunavut	. .	. .	. .	. .	. .	. .	710 082	. .	498 230	70.2	441 270	88.6	3 623 559	821.2
Total	13 286 110	83.3	43 953 640	330.8	7 842 504	17.8	4 709 632	60.1	10 307 368	218.9	11 161 570	108.3	16 904 955	151.5

Source: Provincial and territorial mining recorders.
. . Not available (r) Revised.
(a) Prior to 1999, Saskatchewan data do not include exploration permits. (b) Percentage based on new claims staked in 1999 in the Northwest Territories and Nunavut combined.
(1) Excludes coal.
Note: Numbers may not add to totals due to rounding.

TABLE 6b. AREA[1] OF NEW MINERAL CLAIMS STAKED OR RECORDED BY PROVINCE AND TERRITORY AS A PERCENTAGE OF TOTAL CANADA, 2000-2002

Province/Territory	2000		2001		2002	
	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)
Newfoundland and Labrador	324 225	3.1	391 625	3.5	828 150	4.9
Nova Scotia	96 819	0.9	87 722	0.8	147 713	0.9
New Brunswick	49 344	0.5	35 712	0.3	33 888	0.2
Quebec	2 187 551	21.2	2 115 424	19.0	3 290 446	19.5
Ontario	874 896	8.5	981 904	8.8	813 424	4.8
Manitoba	1 759 381	17.1	1 054 106	9.4	1 287 997	7.6
Saskatchewan	523 440	5.1	558 131	5.0	339 490	2.0
Alberta	2 349 600	22.8	4 192 055	37.6	4 670 028	27.6
British Columbia	699 050	6.8	636 800	5.7	688 500	4.1
Yukon	(r) 53 413	0.5	(r) 40 644	0.4	81 872	0.5
Northwest Territories	891 419	8.6	626 177	5.6	1 099 888	6.5
Nunavut	498 230	4.8	441 270	4.0	3 623 559	21.4
Total	10 307 368	100.0	11 161 570	100.0	16 904 955	100.0

Source: Provincial and territorial mining recorders.
(r) Revised.
(1) Excludes coal.
Note: Numbers may not add to totals due to rounding.

TABLE 7a. EXPLORATION AND DEPOSIT APPRAISAL, OFF-MINE-SITE AND ON-MINE-SITE EXPENDITURES,[1] BY PROVINCE AND TERRITORY, 2002

Province/Territory	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal	
	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site
			($000)			
Newfoundland and Labrador	15 945	1 077	26 909	254	42 854	1 330
Nova Scotia	1 964	–	1 361	61	3 325	61
New Brunswick	3 206	–	–	–	3 206	–
Quebec	63 662	18 024	16 502	13 020	80 163	31 044
Ontario	81 513	27 278	24 161	6 018	105 673	33 296
Manitoba	21 743	5 634	40	2 414	21 783	8 048
Saskatchewan	26 650	226	14 035	515	40 685	741
Alberta	5 186	418	–	–	5 186	418
British Columbia	31 354	1 370	5 562	940	36 916	2 310
Yukon	7 561	–	233	–	7 794	–
Northwest Territories	29 127	–	42 966	641	72 094	641
Nunavut	59 227	2 382	14 243	–	73 471	2 382
Total	347 137	56 408	146 012	23 863	493 149	80 272
Total (on- plus off-mine-site)	403 545		169 876		573 421	

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil.
(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs.
Note: Numbers may not add to totals due to rounding.

TABLE 7b. EXPLORATION AND DEPOSIT APPRAISAL, OFF-MINE-SITE AND ON-MINE-SITE EXPENDITURES,[1] BY PROVINCE AND TERRITORY, 2003

Province/Territory	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal	
	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site
			($000)			
Newfoundland and Labrador	16 790	735	865	4 640	17 654	5 375
Nova Scotia	5 508	–	1 337	63	6 845	63
New Brunswick	1 987	–	–	–	1 987	–
Quebec	80 648	15 638	12 343	14 959	92 991	30 597
Ontario	139 247	33 483	32 882	6 994	172 129	40 477
Manitoba	20 509	7 906	–	1 579	20 509	9 485
Saskatchewan	31 960	55	19 093	1 819	51 053	1 874
Alberta	4 242	213	–	–	4 242	213
British Columbia	42 918	2 528	12 015	14 375	54 933	16 903
Yukon	18 123	–	225	–	18 348	–
Northwest Territories	29 576	670	25 146	755	54 721	1 425
Nunavut	67 791	938	13 674	–	81 466	938
Total	459 298	62 165	117 580	45 184	576 877	107 349
Total (on- plus off-mine-site)	521 463		162 764		684 227	

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil.

(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs.
Notes: Data for 2003 are revised spending intentions. Numbers may not add to totals due to rounding.

TABLE 8. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, 2000-2003

Province / Territory	2000			2001			2002			2003 (rsi)		
			2000 as a % of 1999 Expenditures			2001 as a % of 2000 Expenditures			2002 as a % of 2001 Expenditures			2003 as a % of 2002 Expenditures
	($ millions)	(%)	(%)	($ millions)	(%)	(%)	($ millions)	(%)	(%)	($ millions)	(%)	(%)
Newfoundland and Labrador	27.3	5.5	87.3	28.4	5.5	104.1	44.2	7.7	155.3	23.0	3.4	52.1
Nova Scotia	3.6	0.7	68.2	2.8	0.5	78.6	3.4	0.6	120.1	6.9	1.0	204.0
New Brunswick	12.1	2.4	119.9	9.5	1.8	78.0	3.2	0.6	33.9	2.0	0.3	62.0
Quebec	94.1	19.0	82.9	102.9	20.1	109.4	111.2	19.4	108.0	123.6	18.1	111.1
Ontario	117.9	23.7	135.0	113.6	22.2	96.4	139.0	24.2	122.3	212.6	31.1	153.0
Manitoba	28.1	5.7	123.1	28.7	5.6	101.9	29.8	5.2	104.1	30.0	4.4	100.5
Saskatchewan	45.6	9.2	104.6	37.5	7.3	82.3	41.4	7.2	110.4	52.9	7.7	127.8
Alberta	7.2	1.5	49.1	4.5	0.9	61.5	5.6	1.0	125.8	4.5	0.7	79.5
British Columbia	35.9	7.2	87.0	29.1	5.7	81.1	39.2	6.8	134.6	71.8	10.5	183.1
Yukon Territory	11.2	2.3	88.1	7.8	1.5	69.5	7.8	1.4	99.8	18.3	2.7	235.4
Northwest Territories	51.4	10.3	61.1	86.6	16.9	168.7	72.7	12.7	83.9	56.1	8.2	77.2
Nunavut	62.1	12.5	106.0	61.3	12.0	98.7	75.9	13.2	123.7	82.4	12.0	108.6
Total	496.7	100.0	98.5	512.9	100.0	103.3	573.4	100.0	111.8	684.2	100.0	119.3
Exploration	342.5	69.0	108.9	381.2	74.3	111.3	403.5	70.4	105.9	521.5	76.2	129.2
Deposit appraisal	154.1	31.0	81.3	131.7	25.7	85.4	169.9	29.6	129.0	162.8	23.8	95.8

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
(rsi) Revised spending intentions.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9a. EXPLORATION ACTIVITIES,[1] BY PROVINCE AND TERRITORY, 2002

Province/Territory	Drilling (Surface and Underground)																
	Diamond		Other				Geophysical										
	Metres	Cost	Metres	Cost	Geochemical	Geology	Ground	Airborne	Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre-Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	(000)	($000)	(000)	($000)							($000)						
Newfoundland and Labrador	56	4 569	–	–	1 225	6 023	1 510	655	186	270	148	4	21	2 268	72	72	17 021
Nova Scotia	5	373	1	63	64	316	271	–	141	3	513	–	23	101	76	20	1 964
New Brunswick	21	1 570	–	–	309	801	307	41	42	18	–	–	–	92	12	15	3 206
Quebec	487	24 639	–	–	3 473	15 704	7 214	8 976	5 308	4 250	406	24	34	8 921	2 668	62	81 686
Ontario	746	53 559	2	997	7 262	18 245	6 333	3 290	4 974	3 280	1 465	55	9	8 098	570	673	108 790
Manitoba	130	11 610	. . .	76	2 499	1 708	2 276	2 843	1 356	2 032	15	–	–	2 797	74	90	27 377
Saskatchewan	116	13 284	2	1 965	723	1 633	2 696	556	–	1 841	1 304	85	–	2 729	58	3	26 876
Alberta	6	1 030	80	451	303	859	426	500	197	224	41	–	–	1 567	4	2	5 603
British Columbia	169	13 860	2	164	3 465	7 588	1 149	356	1 469	916	451	17	2	2 529	614	143	32 724
Yukon	10	2 485	1	321	1 076	1 728	361	20	880	119	150	–	–	357	60	5	7 561
Northwest Territories	20	5 143	3	2 510	6 948	1 437	2 981	3 684	–	301	56	11	–	5 365	293	398	29 127
Nunavut	64	17 517	7	2 566	14 424	4 056	3 104	5 511	3 095	2 175	42	–	–	8 536	230	352	61 609
Total	1 830	149 640	99	9 113	41 771	60 097	28 628	26 432	17 647	15 417	4 590	195	88	43 361	4 731	1 836	403 545
Percentage of grand total	n.a.	37.1	n.a.	2.3	10.4	14.9	7.1	6.5	4.4	3.8	1.1	. . .	. . .	10.7	1.2	0.5	100.0

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9b. DEPOSIT APPRAISAL ACTIVITIES,[1] BY PROVINCE AND TERRITORY, 2002

Province/Territory	Drilling (Surface and Underground)																
	Diamond		Other				Geophysical										
	Metres	Cost	Metres	Cost	Geochemical	Geology	Ground	Airborne	Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	(000)	($000)	(000)	($000)							($000)						
Newfoundland and Labrador	10	3 959	–	–	43	61	160	–	160	10	12 479	6	7 379	2 659	47	–	27 162
Nova Scotia	–	–	–	–	–	9	–	–	–	–	365	130	80	452	386	–	1 422
New Brunswick	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Quebec	255	12 989	–	–	111	270	144	–	8 403	2 111	2 253	665	387	1 434	735	–	29 522
Ontario	100	6 244	. . .	418	199	940	345	86	1 579	391	4 120	27	8 781	4 817	1 374	859	30 179
Manitoba	42	2 414	–	–	–	–	–	–	–	–	16	–	–	4	20	–	2 454
Saskatchewan	–	–	–	–	–	–	515	–	–	7 304	3 367	–	750	1 958	666	–	14 550
Alberta	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
British Columbia	22	1 814	2	240	–	136	–	–	18	166	384	148	1 950	604	1 002	59	6 502
Yukon	–	–	–	–	14	2	–	–	–	4	–	36	–	27	105	45	233
Northwest Territories	12	4 617	10	11 942	78	641	–	–	–	8 225	966	–	2 696	5 939	8 500	–	43 607
Nunavut	35	8 157	. . .	114	179	870	–	–	–	–	611	–	1 148	946	2 217	1	14 243
Total	476	40 193	13	12 714	623	2 928	1 164	86	10 161	18 210	24 532	1 033	23 174	19 041	15 052	964	169 876
Percentage of grand total	n.a.	23.7	n.a.	7.5	0.4	1.7	0.7	0.1	6.0	10.7	14.4	0.6	13.6	11.2	8.9	0.6	100.0

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9c. EXPLORATION PLUS DEPOSIT APPRAISAL ACTIVITIES,[1] BY PROVINCE AND TERRITORY, 2002

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland and Labrador	66	8 528	–	–	1 268	6 084	1 670	655	345	280	12 625	10	7 400	5 127	120	72	44 184
Nova Scotia	5	373	1	63	64	325	271	–	141	3	878	130	103	553	462	20	3 386
New Brunswick	21	1 570	–	–	309	801	307	41	42	18	–	–	–	92	12	15	3 206
Quebec	741	37 628	–	–	3 583	15 975	7 357	8 976	13 711	6 370	2 659	709	421	10 355	3 403	62	111 208
Ontario	846	59 802	3	1 415	7 461	19 185	6 678	3 376	6 554	3 651	5 585	82	8 790	12 916	1 944	1 532	138 970
Manitoba	172	14 024	. . .	76	2 499	1 708	2 276	2 843	1 356	2 032	31	–	–	2 801	94	90	29 831
Saskatchewan	116	13 284	2	1 965	723	1 633	3 211	556	–	9 145	4 661	85	750	4 687	724	3	41 426
Alberta	6	1 030	80	451	303	859	426	500	197	224	41	–	–	1 567	4	2	5 603
British Columbia	191	15 674	5	404	3 485	7 724	1 149	356	1 487	1 082	815	165	1 952	3 134	1 617	203	39 225
Yukon	10	2 485	1	321	1 090	1 730	361	20	880	123	150	36	–	384	165	50	7 794
Northwest Territories	32	9 760	13	14 452	7 027	2 078	2 981	3 684	–	8 525	1 024	11	2 698	11 304	8 793	398	72 735
Nunavut	99	25 674	7	2 680	14 603	4 926	3 104	5 511	3 095	2 175	653	–	1 148	9 482	2 447	353	75 853
Total	2 306	189 832	112	21 828	42 394	63 026	29 792	26 518	27 807	33 627	29 123	1 228	23 262	62 402	19 783	2 800	573 421
Percentage of grand total	n.a.	33.1	n.a.	3.8	7.4	11.0	5.2	4.6	4.8	5.9	5.1	0.2	4.1	10.9	3.4	0.5	100.0

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9d. MINE COMPLEX DEVELOPMENT ACTIVITIES,[1] BY PROVINCE AND TERRITORY, 2002

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland and Labrador	2	110	121	2 082	5	4	–	–	14 049	150	506	–	100	12 467	170	49 969	79 612
Nova Scotia	1	53	149	225	–	19	–	–	4 180	115	120	–	–	246	558	111	5 627
New Brunswick	29	8 142	–	–	35	50	–	481	25 694	9 700	–	–	–	1 024	2 708	10	47 844
Quebec	148	5 310	56	3 294	397	2 174	53	–	171 137	3 725	4 020	89	–	13 348	12 397	49	215 995
Ontario	481	24 645	146	1 936	134	5 819	196	–	152 452	619	1 374	–	26	8 925	29 658	10	225 796
Manitoba	180	8 267	–	–	365	491	–	–	68 871	108	731	–	–	1 032	205	–	80 070
Saskatchewan	53	2 060	45	7 609	–	–	80	–	14 059	–	310	–	–	14 000	3 497	104	41 719
Alberta	3	4 071	4	262	2	97	–	–	29 078	157	1 458	102	205	2 017	16 643	48	54 137
British Columbia	47	2 318	42	2 493	754	1 082	237	–	8 870	721	386	86	401	7 859	4 100	1	29 309
Yukon	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Northwest Territories	–	–	27	133	–	443	–	–	32 507	641	970	–	–	30 477	3 859	1 584	70 615
Nunavut	2	186	–	–	18	205	–	–	11 458	–	286	–	–	–	–	7	12 160
Total	945	55 163	592	18 034	1 709	10 384	566	481	532 357	15 937	10 162	277	732	91 395	73 796	51 891	862 885
Percentage of grand total	n.a.	6.4	n.a.	2.1	0.2	1.2	0.1	0.1	61.7	1.8	1.2	. . .	0.1	10.6	8.6	6.0	100.0

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 10. SUMMARY OF DRILLING ACTIVITY IN CANADA, 2002

	Exploration				Deposit Appraisal				Exploration Plus Deposit Appraisal
Drilling Activity	Off-Mine-Site		On-Mine-Site		Off-Mine-Site		On-Mine-Site		On- Plus Off-Mine-Site
	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)
Diamond drilling									
Surface	1 171 529	98.7	184 619	28.7	168 092	84.0	33 910	12.3	1 558 150
Underground	15 874	1.3	458 057	71.3	32 051	16.0	241 583	87.7	747 565
Subtotal	1 187 403	100.0	642 676	100.0	200 143	100.0	275 493	100.0	2 305 715
Percentage of work phase total diamond drilling	64.9		35.1		42.1		57.9		
Other drilling									
Surface	20 471	100.0	78 515	100.0	12 802	100.0	–	–	111 788
Underground	–	–	–	–	–	–	–	–	–
Subtotal	20 471	100.0	78 515	100.0	12 802	100.0	–	–	111 788
Percentage of work phase total other drilling	20.7		79.3		100.0		–		n.a.
Total surface drilling	1 192 000		263 134		180 894		33 910		1 669 938
Total underground drilling	15 874		458 057		32 051		241 583		747 565
Grand total	1 207 874		721 191		212 945		275 493		2 417 503

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; n.a. Not applicable.
Note: Numbers may not add to totals due to rounding.

TABLE 11a. EXPLORATION PLUS DEPOSIT APPRAISAL (SURFACE DRILLING),(1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY, 2002

	Metals								
Province/Territory	Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					(000 metres)				
Newfoundland and Labrador	27	25	8	–	4	3	–	–	66
Nova Scotia	–	1	. . .	–	4	1	–	–	5
New Brunswick	2	17	–	–	–	2	–	–	21
Quebec	118	236	–	–	7	3	6	–	370
Ontario	145	404	–	–	18	1	17	–	586
Manitoba	38	26	–	–	2	. . .	3	–	69
Saskatchewan	10	17	–	76	–	–	11	–	114
Alberta	–	–	–	3	–	–	4	80	86
British Columbia	60	107	–	–	7	9	–	11	195
Yukon	3	5	. . .	–	. . .	. . .	–	–	9
Northwest Territories	. . .	6	–	–	. . .	–	38	–	45
Nunavut	16	76	–	–	. . .	–	12	–	104
Total	419	920	8	78	42	19	91	92	1 670

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.
(1) Includes on-mine-site plus off-mine-site drilling activity for diamond and other types of drilling.
Note: Numbers may not add to totals due to rounding.

TABLE 11b. EXPLORATION PLUS DEPOSIT APPRAISAL (UNDERGROUND DRILLING),[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY, 2002

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
	(000 metres)								
Newfoundland and Labrador	–	. . .	–	–	–	–	–	–	. . .
Nova Scotia	–	–	–	–	–	–	–	–	–
New Brunswick	–	–	–	–	–	–	–	–	–
Quebec	7	365	–	–	–	–	–	–	372
Ontario	21	233	–	–	10	–	–	–	263
Manitoba	58	45	–	–	–	–	–	–	103
Saskatchewan	5	–	–	–	–	–	–	–	5
Alberta	–	–	–	–	–	–	–	–	–
British Columbia	–	–	–	–	–	. . .	–	–	. . .
Yukon	–	3	–	–	–	–	–	–	3
Northwest Territories	–	–	–	–	–	–	–	–	–
Nunavut	–	1	–	–	–	–	–	–	1
Total	90	647	–	–	10	. . .	–	–	748

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.
(1) Includes on-mine-site plus off-mine-site drilling activity for diamond and other types of drilling.
Note: Numbers may not add to totals due to rounding.

TABLE 12. COMPARISON OF 2001 AND 2002 EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY MINERAL COMMODITY

Mineral Commodity	2001 Expenditures	2002 as % of 2001 Expenditures	2002 Total Expenditures			
			On-Mine-Site	Off-Mine-Site	On-Mine-Site Plus Off-Mine-Site	Percentage of Total
	($ millions)	(%)	($ millions)			(%)
Base metals (2)	139.4	99.6	15.9	123.0	138.8	24.2
Precious metals (3)	166.9	127.5	59.4	153.4	212.8	37.1
Gold	123.2	142.9	58.3	117.7	176.0	30.7
Platinum group elements	29.9	86.7	0.7	25.2	25.9	4.5
Iron ore	2.2	73.6	0.5	1.2	1.6	0.3
Uranium	27.1	111.0	–	30.1	30.1	5.2
Other metals	18.5	74.7	0.9	12.8	13.8	2.4
Nonmetals	8.6	120.5	1.6	8.7	10.3	1.8
Diamonds	144.7	111.7	0.6	161.0	161.6	28.2
Coal	5.5	79.0	1.2	3.1	4.3	0.8
Total	512.9	111.8	80.3	493.1	573.4	100.0

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil.
(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs.
(2) Includes copper, nickel, lead and zinc. (3) Includes silver, gold and platinum group metals.
Note: Numbers may not add to totals due to rounding.

TABLE 13a. EXPLORATION EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY, 2002

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
	($000)								
Newfoundland and Labrador	6 248	7 163	1 249	47	1 168	1 110	37	–	17 021
Nova Scotia	4	167	30	–	1 059	703	–	. . .	1 964
New Brunswick	586	2 447	–	–	43	130	–	–	3 206
Quebec	33 758	30 637	95	845	476	1 188	14 687	–	81 686
Ontario	24 452	65 835	–	–	4 002	235	14 266	–	108 790
Manitoba	14 263	8 214	–	–	596	105	4 198	–	27 377
Saskatchewan	2 865	2 521	–	15 114	525	–	5 703	149	26 876
Alberta	9	652	–	501	299	–	2 894	1 248	5 603
British Columbia	10 385	18 215	–	–	1 332	1 342	33	1 417	32 724
Yukon	1 766	4 455	87	–	152	1 074	12	16	7 561
Northwest Territories	698	1 765	79	1	144	–	26 439	–	29 127
Nunavut	7 170	21 813	–	278	65	–	32 282	–	61 609
Total	102 203	163 884	1 541	16 786	9 863	5 887	100 551	2 830	403 545

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environmental and land access costs.
Notes: Numbers may not add to totals due to rounding.

TABLE 13b. DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY, 2002

	Metals								
Province/Territory	Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					($000)				
Newfoundland and Labrador	26 574	24	19	–	–	546	–	–	27 162
Nova Scotia	195	97	–	–	195	936	–	–	1 422
New Brunswick	–	–	–	–	–	–	–	–	–
Quebec	3 166	23 167	70	–	2 887	232	–	–	29 522
Ontario	1 631	10 579	–	–	189	280	17 500	–	30 179
Manitoba	2 430	16	–	–	8	–	–	–	2 454
Saskatchewan	–	–	–	13 285	–	1 265	–	–	14 550
Alberta	–	–	–	–	–	–	–	–	–
British Columbia	1 489	1 841	–	–	570	1 164	–	1 437	6 502
Yukon	92	75	–	–	–	–	–	66	233
Northwest Territories	240	105	–	–	75	–	43 187	–	43 607
Nunavut	829	13 009	–	–	–	–	406	–	14 243
Total	36 645	48 913	89	13 285	3 923	4 424	61 094	1 503	169 876

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs.
Note: Numbers may not add to totals due to rounding.

TABLE 13c. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY, 2002

	Metals								
Province/Territory	Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					($000)				
Newfoundland and Labrador	32 821	7 188	1 268	47	1 168	1 655	37	–	44 184
Nova Scotia	198	265	30	–	1 254	1 639	–	. . .	3 386
New Brunswick	586	2 447	–	–	43	130	–	–	3 206
Quebec	36 924	53 804	165	845	3 362	1 420	14 687	–	111 208
Ontario	26 083	76 414	–	–	4 191	515	31 766	–	138 970
Manitoba	16 693	8 230	–	–	604	105	4 198	–	29 831
Saskatchewan	2 865	2 521	–	28 399	525	1 265	5 703	149	41 426
Alberta	9	652	–	501	299	–	2 894	1 248	5 603
British Columbia	11 874	20 056	–	–	1 902	2 507	33	2 854	39 225
Yukon	1 858	4 530	87	–	152	1 074	12	82	7 794
Northwest Territories	938	1 870	79	1	219	–	69 627	–	72 735
Nunavut	7 999	34 822	–	278	65	–	32 688	–	75 853
Total	138 848	212 797	1 630	30 071	13 786	10 310	161 645	4 333	573 421

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs.
Note: Numbers may not add to totals due to rounding.

TABLE 13d. MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY, 2002

	Metals								
Province/Territory	Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					($000)				
Newfoundland and Labrador	60 780	6 565	11 374	–	–	893	–	–	79 612
Nova Scotia	–	7	–	–	–	4 819	–	801	5 627
New Brunswick	24 420	16 280	–	–	–	7 144	–	–	47 844
Quebec	53 539	95 988	38 608	–	15 082	12 777	–	–	215 995
Ontario	96 055	121 952	–	–	5 067	2 723	–	–	225 796
Manitoba	64 673	15 379	–	–	–	18	–	–	80 070
Saskatchewan	3 455	4 470	–	18 881	–	8 761	–	6 153	41 719
Alberta	–	–	–	–	–	4 908	–	49 229	54 137
British Columbia	6 582	2 846	–	–	5 249	948	–	13 685	29 309
Yukon	–	–	–	–	–	–	–	–	–
Northwest Territories	–	7 165	–	–	2 385	–	61 064	–	70 615
Nunavut	–	12 160	–	–	–	–	–	–	12 160
Total	309 504	282 812	49 983	18 881	27 783	42 990	61 064	69 868	862 885

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs.
Note: Numbers may not add to totals due to rounding.

TABLE 14. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES,[1] BY JUNIOR AND SENIOR COMPANIES AND BY MINERAL COMMODITY, 2002

Work Phase/ Type of Company	Base Metals	Precious Metals	Uranium	Diamonds	Others	Total
			($000)			
Exploration, off-mine-site						
Junior companies and prospectors	38 086	80 379	1 837	41 320	10 780	172 402
Senior companies	51 961	42 530	14 949	59 231	6 063	174 735
Total	90 048	122 910	16 786	100 551	16 843	347 137
Exploration, on-mine-site						
Junior companies and prospectors	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Senior companies	12 155	40 975	–	–	3 278	56 408
Total	12 155	40 975	–	–	3 278	56 408
Exploration, off- plus on-mine-site						
Junior companies and prospectors	38 086	80 379	1 837	41 320	10 780	172 402
Senior companies	64 116	83 505	14 949	59 231	9 342	231 143
Total	102 203	163 884	16 786	100 551	20 121	403 545
Deposit appraisal, off-mine-site						
Junior companies and prospectors	2 001	10 747	–	406	5 237	18 391
Senior companies	30 902	19 694	13 285	60 047	3 694	127 621
Total	32 903	30 441	13 285	60 453	8 931	146 012
Deposit appraisal, on-mine-site						
Junior companies and prospectors	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Senior companies	3 742	18 472	–	641	1 008	23 863
Total	3 742	18 472	–	641	1 008	23 863
Deposit appraisal, off- plus on-mine-site						
Junior companies and prospectors	2 001	10 747	–	406	5 237	18 391
Senior companies	34 644	38 166	13 285	60 688	4 702	151 485
Total	36 645	48 913	13 285	61 094	9 939	169 876
Exploration plus deposit appraisal, off- plus on-mine-site						
Junior companies and prospectors	40 087	91 126	1 837	41 726	16 017	190 793
Senior companies	98 761	121 671	28 234	119 918	14 044	382 628
Total	138 848	212 797	30 071	161 645	30 060	573 421

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; n.a. Not applicable.
(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs.
Note: Numbers may not add to totals due to rounding.

TABLE 15a. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY JUNIOR AND SENIOR COMPANIES, 2002

	Exploration			Deposit Appraisal			Exploration Plus Deposit Appraisal		
Province/Territory	Junior Companies and Prospectors	Senior Companies	Total	Junior Companies and Prospectors	Senior Companies	Total	Junior Companies and Prospectors	Senior Companies	Total
					($000)				
Newfoundland and Labrador	10 722	6 299	17 021	287	26 875	27 162	11 009	33 175	44 184
Nova Scotia	1 849	115	1 964	1 360	63	1 422	3 209	177	3 386
New Brunswick	3 082	125	3 206	–	–	–	3 082	125	3 206
Quebec	27 395	54 290	81 686	4 734	24 788	29 522	32 129	79 078	111 208
Ontario	49 717	59 074	108 790	1 302	28 877	30 179	51 019	87 951	138 970
Manitoba	4 415	22 962	27 377	40	2 414	2 454	4 455	25 377	29 831
Saskatchewan	4 966	21 911	26 876	750	13 800	14 550	5 716	35 711	41 426
Alberta	1 963	3 641	5 603	–	–	–	1 963	3 641	5 603
British Columbia	23 684	9 040	32 724	4 457	2 045	6 502	28 141	11 085	39 225
Yukon	6 700	861	7 561	84	149	233	6 784	1 010	7 794
Northwest Territories	11 171	17 956	29 127	420	43 187	43 607	11 591	61 144	72 735
Nunavut	26 738	34 871	61 609	4 958	9 286	14 243	31 696	44 156	75 853
Total	172 402	231 143	403 545	18 391	151 485	169 876	190 793	382 628	573 421

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs.
Note: Numbers may not add to totals due to rounding.

TABLE 15b. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY JUNIOR AND SENIOR COMPANIES, 2003

	Exploration			Deposit Appraisal			Exploration Plus Deposit Appraisal		
Province/Territory	Junior Companies and Prospectors	Senior Companies	Total	Junior Companies and Prospectors	Senior Companies	Total	Junior Companies and Prospectors	Senior Companies	Total
					($000)				
Newfoundland and Labrador	12 962	4 563	17 525	855	4 650	5 505	13 817	9 213	23 029
Nova Scotia	5 217	291	5 508	1 337	63	1 400	6 554	354	6 908
New Brunswick	1 965	22	1 987	–	–	–	1 965	22	1 987
Quebec	40 540	55 746	96 286	6 340	20 962	27 302	46 880	76 708	123 588
Ontario	60 214	112 516	172 730	4 278	35 598	39 876	64 491	148 115	212 606
Manitoba	7 567	20 848	28 415	–	1 579	1 579	7 567	22 427	29 994
Saskatchewan	10 995	21 020	32 014	70	20 842	20 912	11 065	41 862	52 926
Alberta	1 612	2 843	4 455	–	–	–	1 612	2 843	4 455
British Columbia	39 606	5 839	45 446	6 990	19 400	26 390	46 596	25 239	71 835
Yukon	16 795	1 328	18 123	225	0	225	17 020	1 328	18 348
Northwest Territories	12 364	17 882	30 246	2 600	23 301	25 901	14 964	41 182	56 146
Nunavut	36 450	32 279	68 729	11 712	1 962	13 674	48 163	34 241	82 404
Total	246 288	275 175	521 463	34 406	128 357	162 764	280 694	403 532	684 227

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs.
Notes: Numbers may not add to totals due to rounding. Data for 2003 are revised spending intentions.

TABLE 16. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,[a] BY PROVINCE AND TERRITORY, BY TYPE OF COMPANY, 2002

Province/Territory	(1) Companies With a Producing Mine in Canada	(2) Affiliates of (1)	(3) Oil Companies	(4) Foreign Companies Excluding (1-3)	(5) Junior Companies and Prospectors	(6) Other Companies	(7) Total
				($ 000)			
Newfoundland and Labrador	32 159	797	–	130	11 009	89	44 184
Nova Scotia	70	–	107	–	3 209	–	3 386
New Brunswick	80	–	–	–	3 082	45	3 206
Quebec	63 514	5 391	–	2 697	32 129	7 477	111 208
Ontario	61 946	1 278	–	23 308	51 019	1 418	138 970
Manitoba	16 829	3 520	–	2 249	4 455	2 779	29 831
Saskatchewan	29 055	2 119	–	4 537	5 716	–	41 426
Alberta	1 834	1 806	–	–	1 963	–	5 603
British Columbia	10 867	10	198	–	28 141	11	39 225
Yukon	975	3	–	14	6 784	16	7 794
Northwest Territories	21 796	1 189	–	36 898	11 591	1 260	72 735
Nunavut	11 664	19 824	163	12 506	31 696	–	75 853
Total	250 789	35 936	468	82 339	190 793	13 096	573 421

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil.
(a) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access costs.
Notes: Senior companies include categories 1, 2, 3, 4 and 6. Numbers may not add to totals due to rounding.

TABLE 17. DEPOSIT APPRAISAL, OFF-MINE-SITE, PROJECTS BY PROVINCE AND TERRITORY, BY JUNIOR AND SENIOR COMPANIES, 2001-2002

	2001			2002		
	Projects	Costs (a)	Cost Per Project	Projects	Costs (a)	Cost Per Project
	(no.)	($000)	($000)	(no.)	($000)	($000)
Newfoundland and Labrador						
Junior	2	1 333	666	3	287	96
Senior	2	8 846	4 423	2	26 622	13 311
Nova Scotia						
Junior	5	1 796	359	2	1 360	680
Senior	1	x	x	2	42	21
New Brunswick						
Junior	–	–	–	–	–	–
Senior	–	–	–	–	–	–
Quebec						
Junior	7	3 500	500	7	4 734	676
Senior	8	13 666	1 708	11	13 478	1 225
Ontario						
Junior	9	1 910	212	7	1 309	187
Senior	4	3 387	847	7	38 714	5 531
Manitoba						
Junior	3	760	253	1	x	x
Senior	–	–	–	–	–	–
Saskatchewan						
Junior	–	–	–	1	x	x
Senior	1	x	x	2	x	x
Alberta						
Junior	–	–	–	–	–	–
Senior	–	–	–	–	–	–
British Columbia						
Junior	7	2 181	312	7	4 465	638
Senior	1	x	x	1	x	x
Yukon						
Junior	6	406	68	3	539	180
Senior	–	–	–	3	216	72
Northwest Territories						
Junior	2	990	495	2	430	215
Senior	3	45 748	15 249	4	42 616	10 654
Nunavut						
Junior	4	7 673	1 918	2	5 459	2 729
Senior	2	753	377	3	9 286	3 095
Subtotal, junior	45	20 549	457	35	19 372	553
Subtotal, senior	22	85 678	3 894	35	150 278	4 294
Total	67	106 227	1 585	70	169 650	2 424

Source: Natural Resources Canada, from a federal-provincial/territorial survey of mining and exploration companies.
– Nil; x Confidential.
(a) Deposit appraisal expenditures include field work, overhead, engineering, economic and pre- or production feasibility studies, environmental, land access, non-residential construction (capital and repair), and machinery and equipment costs.

TABLE 18. GENERALIZED MODEL OF THE MINERAL RESOURCE DEVELOPMENT AND MINING PROCESS

PHASE	MINERAL RESOURCE ASSESSMENT	MINERAL EXPLORATION					MINERAL DEPOSIT APPRAISAL				MINE COMPLEX DEVELOPMENT	MINE PRODUCTION	ENVIRONMENTAL RESTORATION
		GRASS-ROOTS EXPLORATION											
	MRA	EX-1	EX-2	EX-3	EX-4	EX-5	DA-1	DA-2	DA-3	DA-4	MCD	MP	ER
STAGE	Various surveys, research and synthesis.	Exploration planning.	Regional reconnaissance and surveys.	Prospecting and ground surveys of anomalies.	Verification of anomalies and showings.	Discovery and delimitation of a mineral deposit.	Mineral deposit definition.	Project engineering.	Project economics.	Feasibility study, production decision.	Mine development, construction of processing plant and infrastructure	Production, marketing and renewal of reserves.	Mine complex closure and decommissioning, site restoration.
OBJECTIVES	Supply information and tools required to develop the mineral potential of the nation for economic benefit, in the perspective of sustainable development.	Select target commodities. Establish exploration objectives and strategies. Select target areas and sites. Acquire claims or permits if appropriate.	Seek anomalies of interest over wide areas by various survey methods. Select the more promising targets. Acquire claims or permits.	Confirm the presence, exact location and characteristics of anomalies. Acquire claims, leases and properties.	Investigate the cause of anomalies. Find mineral showings. Acquire additional claims, leases and properties.	Discover, delimit and interpret grade, quality and tonnage of a new mineral deposit. Determine if it constitutes a mineral resource of "potential economic interest" to justify more intensive and detailed work.	Define the limits, controls and internal distribution of grades, mineralogy and mineral processing characteristics of the deposit. Acquire all data required for project engineering and cost estimation.	Determine, in an iterative fashion, the design, plans, schedules, capital cost and operating cost estimates for all aspects of the project. Establish technical feasibility and costs thoroughly and realistically.	Obtain all the information required and determine, based on corporate objectives, parameters for the economic, financial and social-political evaluation of the project.	Diligently validate and integrate project data, interpretations, estimations, plans and evaluations to achieve MCD and production objectives. Decide on whether to undertake the mining project. Obtain permits and financing.	Complete mine development and construction on schedule and within budgets and specifications. Ensure efficient and timely mine complex start-up according to schedule, specifications and cash flow forecasts.	Achieve commercial production on schedule and meet cash flow forecasts and quantity and quality specifications. Achieve mine profitability and company survival in the perspective of sustainable development.	Restore mine site, outside plant and infrastructure to environmentally acceptable condition. Ensure the future quality of the environment.
EVALUATION METHODS	Geoscientific, mineral and economic surveys, research, compilations and synthesis by governments, research institutes, universities and industry.	Metal and mineral market research. Review of geological and ore deposit information and of the legal, fiscal and socio-political context in various areas.	Remote sensing, aerial photography and airborne geophysics. Prospecting, geology and geochemistry. Appraisal, rating and selection of anomalies.	Ground, geological, geochemical and geophysical prospecting and surveys. Compilation, appraisal and selection of significant anomalies.	Geological mapping and other surveys. Trenching, drilling and sampling. Appraisal of results, recommendations for further work, and selection of new targets.	Stripping, trenching, mapping, sampling, drilling and down-hole geophysics. Initial mineral processing tests. Environmental and site surveys. Mineral resource estimation and inventory.	Detailed mapping, sampling and drilling on surface or from underground. Systematic mineralogy and mineral processing tests. Detailed environmental and site surveys. Prefeasibility studies.	Pilot tests, engineering design and planning. Capital and operating costs for mining, mineral processing, infrastructure, environmental protection and restoration. Technical risk analysis. Prefeasibility studies.	Market, prices, product development and financial studies. Environmental, economic, financial, and socio-political risk analysis. Prefeasibility studies.	Exhaustive due diligence review of all data, interpretations, plans and estimates. Evaluation of profitability, given the geological, technical, financial and qualitative risks, and the up-side factors.	Project management methods in a quality assurance perspective. Training program for personnel and detailed start-up plan to meet the requirements of this demanding period.	Production management methods to ensure continuous quality and efficiency improvements. Exploration, deposit appraisal and development of new zones or deposits on-mine-site and off-mine-site.	Mine closure and decommissioning. Environmental restoration and monitoring.
RESULTS	Maps, data bases, tools and models.	Exploration projects.	Regional anomalies.	Local anomalies.	Mineral showings.	Mineral deposit.	. Deposit appraisal project.			Mining project.	Mining complex.	Mineral production.	Restored site.
MINERAL INVENTORY	UNDISCOVERED MINERAL POTENTIAL					INFERRED RESOURCE	DELIMITED MINERAL RESOURCE				MINERAL RESERVE		
	SPECULATIVE			HYPOTHETICAL			INDICATED	INDICATED AND MEASURED			PROVEN AND PROBABLE		
ESTIMATION ERROR (targeted margin of error of tonnage/grade estimates at the 90% confidence level)						± 100%	± 50%	Indicated: ± 50 to ± 30% Measured: ± 20 to ± 10% (often several sample grid dimensions are used in each category)			Proven (feasibility: ± 10%; mining: ± 5%)		
INVESTMENTS	Moderate	Low, but increasing multiple investments.					Larger and increasing multiple investments.				Very large industrial investment.		Full compliance
RISK LEVEL	Low	Very high, but decreasing risk of failure and financial loss.					High, but decreasing risk of failure.				Moderate to low industrial risk.		

Sources: Modified by D.A. Cranstone, A. Lemieux and M. Vallée, February 25, 1994, from M. Vallée, 1992, *Guide to the Evaluation of Gold Deposits*, CIM Special Volume 45, p. 4, and *SOQUEM Annual Report*, 1976-77, pp. 4 and 5. Revised by M. Vallée and G. Bouchard, January 2001.

APPENDIX 1. FEDERAL, PROVINCIAL AND TERRITORIAL TAX INCENTIVES FOR MINERAL EXPLORATION

Jurisdiction	Incentive	Description	Date		Notes
			Introduced	End	
Federal	Mining exploration flow-through shares	Mechanism allowing the transfer of deductions related to Canadian Exploration Expenses (CEE) and Canadian Development Expenses (CDE) to investors.	1983(1)	No sunset date	(1) In fact, flow-through shares were introduced in 1954. However they only became popular in 1983 when the depletion allowance associated with CEE became transferable to investors.
	Investment Tax Credit for Exploration (ITCE)	15% non-refundable investment tax credit for individual investors in flow-through shares (FTS) of qualifying companies. Eligible expenses relate to grass-roots exploration from or above surface.	Oct. 2000	Dec. 2004	End date is December 2004 for raising funds and December 2005 for completing grass-roots exploration work.
Quebec	Additional deduction program for flow-through shares	Maximum 75% deduction for surface exploration spending revised to a maximum 31.25% deduction in June 2003. Applies to flow-through-share investors paying taxes to the province.	1983	Dec. 2004	Will be fully replaced by refundable tax credit.
	Refundable tax credit for resources	Maximum 45% tax credit paid directly to corporations (refundable and non-refundable components).	2001	2008	Refundable and non-refundable tax credit rates vary according to type of company and location of exploration project.
Ontario	Ontario Focused Flow-Through Share Tax Credit	5% refundable tax credit for investors in eligible shares of qualifying companies. Applies to investors paying taxes to the province.	Dec. 2000	No sunset date	Harmonized with federal ITCE, but refundable and no sunset date.
Manitoba	Manitoba Mineral Exploration Tax Credit (MMETC)	Non-refundable 10% personal income tax credit for investors in eligible flow-through shares of qualifying companies. Applies to investors paying taxes to the province.	Apr. 2002	Dec. 2004	Harmonized with federal ITCE.
Saskatchewan	Mineral Exploration Tax Credit	Income tax credit of 10% for investors in eligible flow-through shares of qualifying companies. Applies to investors paying taxes to the province.	Mar. 2001	Dec. 2004	Harmonized with federal ITCE.
British Columbia	Mining Flow-Through Shares Tax Credit (BC MFTS)	Non-refundable 20% tax credit for investors in eligible flow-through shares of qualifying companies. Applies to investors paying taxes to the province.	July 2001	Dec. 2004	Harmonized with federal ITCE.
	Mining Exploration Tax Credit (METC)	20% refundable tax credit on eligible mineral exploration. Paid directly to companies or individuals incurring the expenses.	Aug. 1998	July 2006	Cannot be used concurrently with BC MFTS. Partly harmonized with federal CEE rules.
Yukon	Yukon Mineral Exploration Tax Credit (YMETC)	Refundable corporate and personal income tax credit of 22%, revised to 25% in March 2001, of eligible off-mine-site mineral exploration expenditures.	Apr. 1999	Mar. 2004	Subject to annual review. Individuals claiming the credit must be residents of the Yukon. Corporations must have a permanent establishment in the Yukon.

Note: For more information on tax-related exploration incentives, please contact Robert Clark, Tax and Mineral Resources Division, Minerals and Metals Sector, Natural Resources Canada, by telephone at (613) 996-3286 or by e-mail at rclark@nrcan.gc.ca.

Canadian Mineral Exploration and Discovery Analysis

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CANADA'S STANDING AS AN EXPLORATION TARGET

For the purpose of this article, statistics that were current in May 2003 will be used. Hence, the 2001 total for exploration and deposit appraisal expenditures was \$512.9 million, the preliminary total for 2002 was \$534.1 million, and company spending intentions for 2003 totaled \$574 million. However, an August 2003 statistical update reveals that exploration and deposit appraisal expenditures in Canada for the non-petroleum minerals industry actually totaled \$508.9 million in 2001. The new total for exploration spending in 2002 is \$573.4 million and company spending intentions for 2003 now total \$684 million.

The annual survey of world mineral exploration intentions by the Metals Economics Group (MEG) for 2002 indicates that, in 2002, exploration expenditures in Canada (US\$317.1 million) appear to have exceeded those in Australia (US\$304.4 million). Canada has not been ahead of Australia in terms of mineral exploration expenditures since 1991 (Figure 1). The MEG survey puts the United States in third place in 2002 (US\$125.2 million) followed by Peru (US\$102.9 million). Given the fact that the geographical area of Peru is so much smaller than that of Canada, Australia and the United States, the intensity of mineral exploration per unit area in Peru must have exceeded that in Canada, Australia and the United States. The MEG survey indicated that for the commodities they survey, exploration budgets worldwide totaled only US\$1.9 billion, the lowest level since at least 1993.

The MEG survey was for spending intentions for 2002, not amounts actually spent during the year, and the official government exploration surveys for Canada and Australia should ultimately provide a more reliable comparison of exploration spending in those two countries.

Figure 1
Top Three Country Destinations of Mineral Exploration Capital from Worldwide Sources, 1977-2002

	Rank		
Year	First	Second	Third
2002	Canada (?)	Australia (?)	United States
2001	Australia	**Canada**	United States
2000	Australia	**Canada**	United States
1999	Australia	**Canada**	United States
1998	Australia	**Canada**	United States
1997	Australia	**Canada**	United States
1996	Australia	**Canada**	United States
1995	Australia	**Canada**	United States
1994	Australia	**Canada**	United States
1993	Australia	**Canada**	United States
1992	Australia	**Canada**	United States
1991	**Canada**	Australia	United States
1990	**Canada**	Australia	United States
1989	**Canada**	Australia	United States
1988	**Canada**	Australia	United States
1987	**Canada**	Australia	United States
1986	**Canada**	Australia	United States
1985	**Canada**	Australia	United States
1984	**Canada**	Australia	United States
1983	**Canada**	Australia	United States
1982	**Canada**	Australia	United States
1981	**Canada**	Australia	United States
1980	Australia	**Canada**	United States
1979	Australia	United States	**Canada**
1978	Australia	United States	**Canada**
1977	United States	**Canada**	Australia

Source: Natural Resources Canada, based on official Canadian and Australian statistics and the best available data for the United States. Data for 2002 based on the Metals Economics Group survey for 2002.
Notes: Australian expenditures were 6.5% higher than those for Canada in 1983 and 3.3% higher in 1991; however, correcting the reported Australian totals for substantial mine development expenditures, which are not included in Canadian statistics, ranks Canada first in 1983 and 1991. Complete data are not available for the former Soviet Union and China.

Still, there are difficulties in comparing even the official Canadian and Australian exploration surveys as follows (see Table 1):

- The Canadian survey is for calendar years (January 1-December 31), while the Australian survey is for fiscal years (July 1-June 30).
- The Canadian survey is in Canadian dollars while the Australian survey is in Australian dollars and the relative values of these currencies are constantly changing.
- Until 1997, the Canadian survey did not include exploration performed at producing mines but, rather, only exploration for separate new orebodies on the properties surrounding producing mines (that is, new orebodies that would actually be mined from a separate new mine). The Australian survey has always included exploration in producing mines. Modifications to the Canadian exploration survey beginning with survey year 1997 include some exploration in areas of certain producing mines for completely new orebodies widely separated from existing ore zones.
- At the time of writing this chapter, the most recent Australian survey covers fiscal year 2001/02 and, therefore, includes only half (to June 30, 2002) of the calendar year 2002 covered by the MEG survey. Until the Australian survey data for fiscal year July 1, 2002, to June 30, 2003, become available later in 2003, it will not be possible to make a meaningful comparison of actual Australian and Canadian exploration expenditures for 2002.

Table 1 represents a comparison, in Canadian dollars, of exploration expenditures in Canada and Australia for calendar years and fiscal years from 1996 to 2002. For Australian fiscal year 2001/02, exploration expenditures in Canada have been calculated to be about C$523.5 million (the average of expenditures in Canada in 2001 and 2002), compared to C$526 million in Australia, amounts that are almost equal.

DIAMONDS

Exploration for diamonds continues on many Canadian properties. In Ontario, De Beers Canada Exploration Inc. has a feasibility study under way for the Victor kimberlite (37 Mt containing diamonds worth about C$94/t) some 90 km west of James Bay. De Beers is also exploring three of seventeen adjacent kimberlites.

In the Fort-à-la-Corne area in Saskatchewan, a number of mini-bulk samples, with a total weight of 1271.9 t, have been taken by De Beers from the 140/141 kimberlite (Kensington Resources Ltd., 42.5%; De Beers, 42.5%; Cameco Corporation, 5.5%; and UEM Inc 10% carried interest). The diamond-bearing heavy mineral concentrates recovered have been shipped to De Beers Consolidated Mines Limited in Johannesburg for diamond recovery and evaluation. The kimberlite size is estimated to exceed 500 Mt. The largest diamond recovered to date is a gem-quality 3.335-ct stone.

At Jackson Inlet, Nunavut, near the northern end of Baffin Island, Twin Mining Corporation continues to explore the Freightrain kimberlite. Mini-bulk samples taken from test pits in 2002 ranging from 2.5 to 76.3 t in size, with a total weight of 228.19 t, yielded 46.206 ct of diamonds of which the 30 largest are of gem quality and range from 0.25 to 1.557 ct.

In the Ungava peninsula of northern Quebec, Twin Mining is exploring a diamondiferous kimberlite dyke system that is up to 2.3 m wide over an outcrop strike length of 37 km. A total of 1.01 t of grab samples taken in 2002, from 900-m and 400-m dyke segments, had average diamond contents of 0.3 ct/t. The five largest diamonds, recovered from a 342-t bulk sample taken in 2001/02, weigh 0.685, 0.566, 0.279, 0.271 and 0.199 ct.

At the Gahcho Kué project, also known as Kennady Lake, located on the AK claim block, a joint venture of De Beers (51%), Mountain Province Diamonds Inc. (44.1%) and Camphor Ventures Inc. (4.9%), a total of 1174 ct of diamonds were recovered from a 665.5-t kimberlite bulk sample taken from five 24-inch-diameter drill holes in the northern lobe of the Hearne pipe. The three largest diamonds recovered weigh 8.7, 6.4 and 4.9 ct. The number of diamonds greater than half a carat (157) is proportionately 31% greater than in a 2001 bulk sample and 15% greater than in a 1999 bulk sample from the same kimberlite.

An 836-t bulk sample from the 5034 diamond pipe yielded 1215 ct with the largest diamonds recovered weighing 7.0, 6.6 and 5.9 ct. A significantly higher proportion of diamonds weighing greater than one carat were recovered in 2002 compared to the 1999 and 2001 bulk samples.

The diamonds recovered from the Hearne and 5034 pipes in 2002 have been sent for valuation.

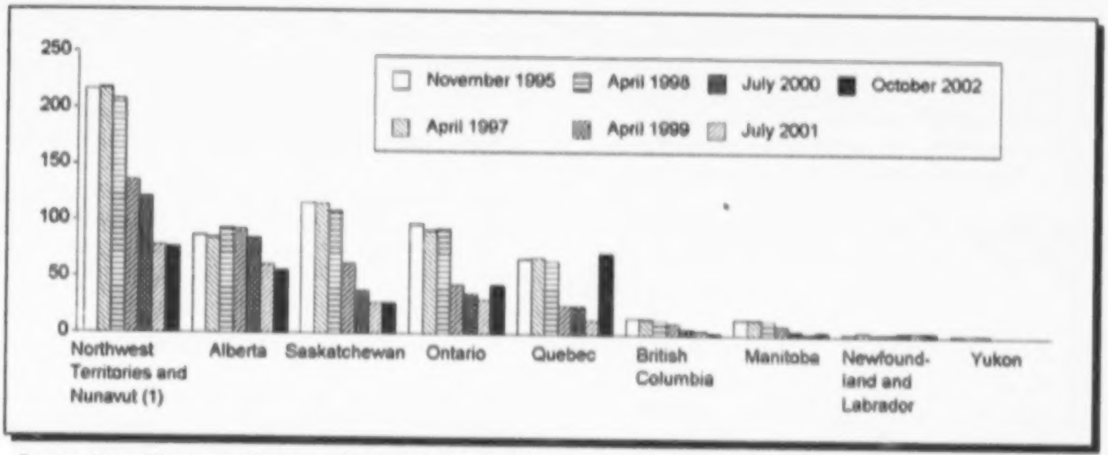
During 2002, additional exploration drilling was carried out on the nearby Tuzo pipe (indicated and inferred resource of approximately 15 Mt).

In October 2002 there were some 300 other diamond exploration or diamond deposit appraisal properties in Canada (Figure 2).

EMERALDS

In the southeastern Yukon, True North Gems Inc. is exploring the Regal Ridge emerald deposit in the Pelly Mountains, 230 km northeast of Whitehorse. Exploration over the 2001 and 2002 field seasons has uncovered eight

Figure 2
Regional Distribution of Diamond Exploration and Deposit Appraisal Properties, 1995-2002



Source: Natural Resources Canada, based on *MIN-MET CANADA* database for 1995-97 and InfoMine database for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

(1) In October 2002 there were 76 in the Northwest Territories and 25 in Nunavut for a total of 101. In July 2001 (2000), there were 78 (112) diamond exploration properties in the Northwest Territories and 10 (9) in Nunavut, for a total of 88 (121) properties in the two territories.

emerald/tourmaline vein systems in the main zone and three additional zones (the Far West, West and Southwest veins). The emeralds were formed more than 65 million years ago. A 113-t bulk sample, taken in 2002, yielded 65 kg of rough emerald concentrate with an expected value of US$57 700, which compares favourably with other world-class emerald deposits. The emerald-bearing material was sorted into three categories: gem quality, near-gem quality and non-gem quality. Gem-quality cut emeralds from the property, viewed by the author in March 2003 at the Annual Conference of the Prospectors and Developers Association of Canada, were highly attractive but none of them were of large size. The Yukon emeralds are reported to be chromium-based emeralds, which means that they are fluorescent and have higher value than the less precious vanadium-based emeralds, which merely reflect green light.

OTHER MINERAL COMMODITIES

In Nunavut, Miramar Mining Corporation continued exploration drilling on its Hope Bay gold property. A feasibility study for the Doris North area was positive and the company is in the process of permitting a 690-t/d operation to mine, mill and recover 311 000 oz of gold over a two-year period. At present, measured and indicated resources at the Hope Bay property contain 1 636 000 oz of gold, with an additional 2 703 000 oz contained in inferred resources. A major exploration program is planned for the Hope Bay project in 2003. Production is planned for early 2005.

Also in Nunavut, Cumberland Resources Ltd. continues exploration of its Meadowbank gold project. A feasibility study is under way and scheduled to be completed in late 2003. A preliminary assessment indicates that the project could support annual production of 250 000 oz of gold over an eight-year mine life at an estimated cash cost of US$168/oz. Exploration expenditures of C$10.3 million are planned for 2003.

A third exploration project in Nunavut is the Starfield Resources Inc. Ferguson Lake project, which is exploring a copper-nickel-PGM deposit, originally discovered in 1952 by Inco Limited. Resources now stand at 60 Mt averaging 0.59% nickel, 0.93% copper, 1.32 g/t palladium and 0.19 g/t platinum, up from the 7.3 Mt averaging 0.80% nickel and 0.70% copper established by Inco in the 1950s. Tests of dense media separation methods are yielding a sink fraction with a recovered grade of 20 g/t platinum plus palladium from a head grade of 3.13 g/t platinum plus palladium. Recoveries in the sink fraction are 83% of the platinum and 74% of the palladium, with an 88% weight rejection.

At Sudbury, Ontario, FNX Mining Company Inc. (75%) and Dynatec Corporation (25%) are exploring former producing mining properties of Inco Limited (McCreedy West, Victoria, Norman, Levack and Kirkwood) under an agreement whereby they can purchase these properties

(Inco retains the right to buy back a 51% interest in any deposit discovered that contains in excess of 600 million lb of nickel equivalent by carrying the 49% remaining FNX-Dynatec ownership share through to production).

Some 15 diamond drills completed 350 000 feet of drilling at the former McCreedy West mine in the last nine months of 2002. More than 2 million short tons of relatively high-grade resources have been outlined at McCreedy West with potential for additional resources at depth, and production at an initial rate of 907 t/d is planned for 2003.

Attractive intersections have also been obtained on the Norman and Victoria properties where exploration continues.

In Saskatchewan, Cameco Corporation announced the discovery of the Millenium uranium deposit (actually discovered in 2000) at a depth of 600 m below surface. The tonnage and grade of the deposit have not been released.

In British Columbia, ongoing exploration on the Kemess property outlined an additional 2 million oz of gold and 227 000 t of copper in the Kemess North deposit and the newly discovered Nugget zone. A feasibility study is in progress with the intent of providing mill feed for the concentrator after the Kemess South orebody has been mined out.

DRC Resources Corporation continued exploration on its Afton copper-gold project where a zone below and to the southwest of the former Afton mine open pit has been estimated to contain 38.4 Mt at a grade of 2.32% copper equivalent, over a length of 1000 metres, with the deposit open to the southwest and northeast. A scoping study by Behre Dolbear & Company Inc. suggests that a 4080-t/d underground block caving operation could yield a 32.3% internal rate of return. A pre-feasibility study is in progress and diamond drilling of the deposit continues.

Notes: (1) Information in this review was current as of May 2003. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002cmy_e.htm.

NOTE TO READERS

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TABLE 1. EXPLORATION EXPENDITURES, CANADA AND AUSTRALIA, 1996-2002

Year	Canada	Australia		
	Calendar Year	Fiscal year		
	(C$ millions)	(A$ millions)	(Avg. Exchange Rate A$/C$)	(C$ million)
1996	894.8			
1996-97	857.5 (average of 1996 & 1997)	1 148.50	1.0700	1229.00
1997	820.2			1129.00
1997-98	698.0 (average of 1997 & 1998)	1 066.80	0.9642	1029.00
1998	575.9			911.50
1998-99	540.1 (average of 1998 & 1999)	837.80	0.9475	794.00
1999	504.3			710.00
1999-2000	501 (average of 1999 & 2000)	676.30	0.9258	626.00
2000	496.7			591.50
2000-2001	505 (average of 2000 & 2001)	683.30	0.8158	557.00
2001	512.9			546.50
2001-02	523.5 (average of 2001 & 2002)	640.60	0.8217	526.00
2002	(p) 534.1			

Source: Natural Resources Canada.
(p) Preliminary.

Canadian Mine Openings, Closings, Expansions, Extensions and New Mine Developments

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OVERVIEW

After four consecutive years of a gold and base-metal mining downturn, mine openings and closings in Canada were more balanced in 2002, halting a downward trend in mine openings that began in the second half of 1997. However, as the mines that closed were, on average, larger than those opened in the year, employment and production were still negative in 2002. The nine mines opened during the year consisted of one new mine (gold) and eight re-openings (four gold, two base-metal, one uranium and one tungsten) (Tables 1 and 2). Of the nine mine closings, six were permanent closures (one gold, four base-metal and one uranium) and three were production suspensions (one gold, one uranium and one industrial mineral). One of the re-opened mines (a base-metal mine) and two of the closed mines (a base-metal mine and a uranium mine) were wholly owned and operated by foreign companies while another uranium mine at which production was suspended is foreign controlled.

The only new mine opened in 2002 was the 200-t/d Mishi open-pit gold mine in northern Ontario. With an estimated output of 7000 oz of gold annually, it is the smallest gold mine in Canada. However, the Mishi mine is a part of the Mishi-Magnacon complex, which may lead to it being expanded into a significantly larger gold operation in the future.

During 2002, six significant underground mines closed in Canada. In Quebec, the Bousquet No. 2 gold-copper mine closed in December because of ore depletion. The mine was brought on stream in 1989. The Bousquet No. 1 mine had been developed earlier for production in 1979. The two mines were consolidated in 1996 with the remaining ore at No. 1 mined through the No. 2 mine. Since 2000, production from the Bousquet complex has been essentially from the No. 2 mine. With an ore capacity of 2450 t/d, an annual gold output exceeding 150 000 oz and a work force of over 300 during normal years of operation, the Bousquet No. 2 mine was one of the most important gold producers in the Abitibi region of Quebec. In Ontario, the Crean Hill nickel-copper mine was mined out and closed in June. It first began production in 1905 and was one of Inco Limited's oldest mines in the Sudbury area. In Saskatchewan, ore reserves were exhausted at the Cluff Lake uranium mine in December. Developed for production in 1980, it was the only uranium mine in Canada that was wholly owned and operated by a foreign company, the French-controlled COGEMA Resources Inc. It is also the only uranium mine situated in northwestern Saskatchewan. The 5800-t/d Ruttan copper-zinc mine in northern Manitoba closed in June after some 30 years of operation due to the depletion of mineable ore reserves. The mine first began production in 1973 and, with a regular work force of some 435 over the years, it had been one of the largest employers in the region. In Nunavut, both the Nanisivik zinc-silver mine on Baffin Island and the Polaris zinc-lead mine on Little Cornwallis Island in the Arctic closed in September as a result of ore depletion. The Nanisivik mine first came into production in 1976 while the Polaris mine came on stream in 1981. Up to the time of its closure, the Polaris mine was the world's most northerly base-metal mine. The two mines employed some 420 in 2002 and were the only base-metal mines in Nunavut.

There were three production suspensions in 2002, negatively affecting some 300 mining jobs. The Hurley slate mine in Newfoundland and Labrador, one of the largest industrial mineral mines in the province, shut down in August due to a licensing dispute between the mine's owner and the Province; production was suspended at the Kiena gold mine in Quebec in September because of high costs; and the McClean Lake uranium mine in northeastern Saskatchewan closed as the result of a federal court order to suspend the operating licence for its ore treatment plant.

In addition to the above production suspensions and mine closures, lower production levels and cutbacks continued at several mines in 2002, especially at gold, base-metal, coal and uranium mines, creating additional employment losses during the year. However, job losses through lower production and cutbacks amounted to less than 200 in 2002 and were largely offset by mine expansion and mine-life extension activities.

Although cost-cutting measures continued at all mines across Canada in 2002, efforts to cut costs through innovation, joint operation, and consolidation of mining operations through mergers and takeovers appeared to taper off in the year, in contrast to the global trends observed since 2000 when gold, zinc, copper and iron ore prices were particularly weak. Nevertheless, two major mergers or takeovers that affected Canadian mining were completed in the first half of 2002. One was the $4.5 billion takeover of Australia's Normandy Mining Ltd. and Canada's Franco-Nevada Mining Corporation Limited by Denver-based Newmont Mining Corporation. The other was the merger of Kinross Gold Corporation, Echo Bay Mines Ltd. and TVX Gold Inc. As well, Placer Dome Inc. and Kinross agreed to form the Porcupine Joint Venture in Ontario. While the Newmont takeover of Franco-Nevada increased the mining interests of Newmont in Canada, the three-way Kinross-Echo Bay-TVX Gold merger reduced foreign mining holdings in Canada. The Placer Dome-Kinross joint project in Ontario is expected to boost mining in the Porcupine gold camp. At least three existing and former Kinross gold mines and Placer Dome's Dome mine, which is scheduled to close in 2005, will likely be maintained, expanded or redeveloped for re-opening. As of December 31, 2002, the Pamour mine and mill will shut down to prepare for redevelopment for re-opening in 2005. As well, the Dome mill will be expanded to accommodate all ores from the joint venture.

There were at least 13 significant mine expansion and extension projects across Canada during the year (Table 2), including 5 precious-metal, 6 base-metal, 1 iron ore and 1 diamond mine. Two of these were new projects and 11 were existing projects that began in recent years. The new projects were the mill expansion at the Troilus gold mine in Quebec and the deepening of the shaft at the Garson nickel-copper mine in Ontario. Existing programs continued at: the Carol Lake iron-ore operation in Labrador; the LaRonde gold-zinc-copper-silver mine and the Niobec niobium mine in Quebec; the Musselwhite and Red Lake gold mines, the Kidd Creek zinc-copper-silver mine, the Creighton and McCreedy East nickel-copper mines and the Lac des Iles palladium-platinum-gold-copper-nickel mine in Ontario; the Birchtree nickel-copper mine in Manitoba; and the Ekati diamond mine in the Northwest Territories. Seven of the thirteen projects (Niobec, Troilus, Musselwhite, Red Lake, Lac des Iles, Garson and Birchtree) were completed in 2002.

The total capital cost for bringing the only new metal mine into production in 2002 was estimated at less than $1 million, the lowest in more than a decade. However, an estimated $68 million was spent on mine re-openings. In contrast, over $450 million is estimated to have been spent by companies on major mine expansions and mine-life extensions, one of the highest totals in over a decade. Given the generally depressed mineral commodity prices and market conditions of recent years, this indicates that relatively high levels of mine-site capital investment, compared with off-site exploration spending, have been maintained in Canada in recent years. It reflects the necessity, despite difficult market conditions, for current producers to maintain, and in some cases expand, production capability through mine-site development to lower production costs, allowing these producers to better position themselves for the up-cycles. For 2003, capital investment is expected to be higher as more mines are expected to open or re-open.

REGIONAL PERSPECTIVE

During 2002, six provinces and two territories were affected by mine openings or closings. In terms of employment, ore capacity and production losses, Nunavut suffered the most, followed by Saskatchewan and Manitoba. In terms of the overall impact on mining, Canada's territories, where gold and base-metal mining once flourished, now have no base-metal mines north of the 60th parallel.

Newfoundland and Labrador

On August 16, 2002, production was suspended at the Hurley slate mine near Trinity Bay due to a licensing dispute between the mine's owner and the Newfoundland and Labrador government that originated from unclear ownership of the mine property. About 48 mining jobs were affected. The Hurley open-pit mine, owned and operated by Hurley Slate Works Inc., was brought on stream in 2000. With a production capacity of 70 t/d, it had been one of the largest industrial mineral mines in the province and the most significant dimension stone producer in the Trinity Bay area.

Quebec

In Quebec, three gold mines re-opened and two closed. The 1100-t/d Beaufor underground mine, where production had been suspended since August 2000 because of pillar instability, resumed production in January at an estimated capital cost of less than $5 million. The mine employs some 100 miners. Gold production in 2002 was 56 065 oz at a cash cost of US$163/oz. Based on mineable reserves of 246 000 oz and production rates at the start of 2003, the remaining mine life is estimated at four to five years. The Sigma-Lamaque open-pit mine near Val-d'Or closed in February 2001 because of high costs and re-opened in November 2002 after successful restructuring and refinancing involving SOQUEM Inc., Investissement Québec, and Canada Economic Development, as well as substantial redevelopment and expansion of its mill from 3000 t/d to 5000 t/d. The capital costs for redeveloping and re-opening were estimated at $34 million. As of early 2003, the mine maintained a work force of some 105 and the mine plan was to produce 110 000 oz of gold in 2003 at a cash cost of US$210/oz. Campbell Resources Inc. re-opened the 1170-t/d Joe Mann underground mine near Chibougamau in March. This followed encouraging results from a 17-month exploration and 4-month redevelopment program following a June 2001 three-way merger with MSV Resources and GeoNova Explorations Inc. Employing 175 miners, the mine produces copper as a by-product.

In September, production at the 2000-t/d Kiena gold mine near Val-d'Or was suspended due to high costs. About 75 jobs were affected. However, recent successes in both surface and underground exploration have been encouraging, with increased resources added to the measured and indicated categories for the Hanging Wall zone and the newly identified P-zone, which has now been traced for over 1.2 km along strike. These results will boost the potential for redevelopment of the Kiena orebody. In production since 1989, the 2450-t/d Bousquet (essentially Bousquet No. 2) gold-copper mine near Cadillac closed in December due to depletion of economic ore reserves. Some 190 workers lost their jobs. A planned closure of the Jeffrey asbestos mine in the Eastern Townships in October was averted due to the intervention of the United States' NASA space shuttle program, which offered a multi-million-dollar contract for an asbestos supply from the mine through ATK Thiokol Propulsion, the supplier of thermal insulant for the space shuttle's solid rocket boosters. However, the contract only required the supply of the high-grade chrysotile asbestos fibre "plastibest" from the Jeffrey mine for a four-month period to allow a stockpile of the fibres sufficient for rocket booster application until 2020 by NASA. Production was subsequently suspended at the Jeffrey mine in April 2003.

Overall, in 2002, Quebec mining faired relatively well with a net gain of some 2800 t of daily ore capacity and the addition of 115 direct mining jobs from mine openings and closings, compared with a net loss of 4400 t of ore capacity and 180 jobs in 2001. However, with the permanent closure of the Bousquet mine and no new mines being developed, Quebec continued to suffer from the recent decline of its gold and base-metal mining industry, which started in 1999 when one base-metal and four gold mines were closed.

Ontario

In Ontario, three mines (two gold and one base-metal) opened and one mine (base-metal) closed in 2002. The mines that opened include the small Mishi open-pit gold mine that was mentioned earlier. In addition, the 900-t/d Macassa underground gold mine near Kirkland Lake re-opened in May. However, the mine did not achieve sustained production at near-commercial level in 2002. Gold production was last suspended at the mine in June 1999 by the former owner, Kinross Gold Corporation, due to weak gold prices and ground stability problems. Foxpoint Resources Ltd. acquired the mine in December 2001. In October 2002, Foxpoint changed its name to Kirkland Lake Gold Inc. While production since the resumption of mining in May came mainly from surface ore stockpiles, underground production from Shaft No. 3 was initiated in January 2003. In February 2003, a significant high-grade north-south trending zone, dubbed the "D zone," was discovered. This zone, which is perpendicular to the main east-west trending ore structure of the mine, has been a new focus for exploration. Mining was halted temporarily in early March 2003 due to a failure of the pillar between an existing ore pass and Shaft No. 3. Gold production is forecast to be between 50 000 and 70 000 oz in 2003. As of January 2003, ore reserves were sufficient to sustain production at the current rate for at least six years. The mine has the potential to increase employment beyond the current estimated 50 with increased production. In October 2002, the 1600-t/d Gertrude open-pit nickel-copper mine in Sudbury re-opened after a shut-down of one year. The mine, employing an estimated 120 workers, has ore reserves to sustain production to at least 2004. While gaining the Gertrude mine for production in 2002, Inco closed the larger 1900-t/d Crean Hill nickel-copper mine, also located in Sudbury. The Crean Hill mine, which first began production in 1905, closed in June due to ore depletion, eliminating some 150 jobs. Overall, in 2002, Ontario incurred small net gains of 800 t/d of ore production capacity and 30 direct mining jobs as a result of mine openings and closings.

Manitoba

During 2002, one mine closed in Manitoba and there were no new mine openings or re-openings. In June, the 5800-t/d Ruttan underground copper-zinc mine near Leaf Rapids in northern Manitoba closed after 30 years of operation due to ore depletion, followed by the closure of the Ruttan concentrator in July, causing the loss of 360 mining jobs. The Ruttan mine was the largest copper-zinc mine, but had the lowest grades in the province. With the closure of Ruttan, there are only three copper and zinc mines left in the province, namely, the 2500-t/d Trout Lake copper-zinc mine and the 1700-t/d Callinan zinc-copper mine near Flin Flon and the 510-t/d Chisel North zinc-copper mine near Snow Lake.

The Chisel North zinc-copper mine near Snow Lake formally began production in July 2000. However, the official opening of the mine by the company was held a year later on June 1, 2001. The mine is a part of the $400 million "777 Project" centred at Flin Flon, under development by Hudson Bay Mining and Smelting Co., Limited. A second mine under the project is the larger 777 mine, which is scheduled to begin production in 2004.

In addition to the two mines, the 777 project would result in an upgraded and more environmentally friendly copper smelter, an expansion of the Flin Flon concentrator, a new-technology electrolytic zinc cellhouse, and many productivity improvements.

Saskatchewan

In 2002, one mine re-opened, one mine suspended production and one mine closed in northern Saskatchewan, all of which were uranium mines. The Eagle Point underground mine at Rabbit Lake, where production had been suspended since March 1999 due to weak uranium prices, resumed mining activities in June, followed by uranium production in August as uranium prices and market outlook continued to improve since the fourth quarter of 2001. The mine currently employs a work force of 150 and is the only uranium mine in Cameco Corporation's Rabbit Lake operation. On September 23, production at the McClean Lake mine was suspended by a Federal Court ruling that quashed the operating licence for the mine's ore-processing plant as the result of a complaint filed by the Inter-Church Uranium Committee Educational Co-operative against the Canadian Nuclear Safety Commission (CNSC). The McClean mine was brought on stream in 1999 by joint-venture partners COGEMA Resources Inc. (CRI), Denison Energy Inc. and OURD (Canada) Co. Ltd. CRI is a wholly owned subsidiary of the Paris-based, French government-controlled COGEMA S.A., whereas OURD (Canada) is wholly owned by OURD of Japan. Mining at McClean Lake was completed in 2001 when the Sue C open pit, the last pit of the mine, was mined out. Mine reclamation has already begun. However, ore stockpiles, including those from the previously mined-out JEB deposit, will provide sufficient feed to the mill for uranium concentrate production for several more years. The 800-t/d Cluff Lake underground mine, owned and operated by CRI, closed in December after all mineable reserves were exhausted. The mine first began production in October 1980 and had been producing some 1000-2000 t of uranium concentrates (U_3O_8) annually. Mine-site reclamation is progressing throughout 2003. As a result of this closure, the province incurred net losses of some 500-t/d of uranium ore production capacity and 225 mine jobs in 2002.

Early in the second quarter of 2003, unexpected inflows of water outstripped the underground pumping capacity of the McArthur River uranium mine and forced the mine to suspend production. By mid-June, remedial work indicated that mine production could resume in early July. Underground drilling successes in the No. 3 and No. 4 zones and reinterpretation of existing drill data for the No. 1 and No. 2 zones, for which ore grades were underestimated, resulted in the outlining of additional ore reserves in 2001 for this operation, which is located some 280 km north of La Ronge. In late January 2001, mine reserves were re-established at 845 000 t grading 21.18% U_3O_8 compared with 668 000 t grading 17.33% U_3O_8 at the end of 1999 when the mine began production. This resulted in a 50% increase in uranium reserves and an additional eight years to the 10-plus years of originally expected mine life at the mine. The McArther River mine is the world's largest and highest grade uranium mine.

British Columbia

One mine re-opened and no mines closed in British Columbia in 2002. The 4000-t/d Myra Falls zinc-copper-gold-silver mine near Campbell River on Vancouver Island resumed production in March following the implementation of an action plan, during a four-month shutdown, to lower costs and make production considerably more efficient. Employing some 360 workers, the mine, as of January 2003, has sufficient ore reserves to support production for another six years at the current rate of production. In addition, the mine hosts 4.6 Mt of measured and indicated resources with slightly higher ore grades. The mine was formerly owned and operated by Boliden Limited, which was redomiciled to Sweden and reintegrated into the Stockholm-based parent company Boliden AB in December 2001. Overall in 2002, the re-opening of the Myra Falls base-metal mine resulted in net gains in ore capacity and mining jobs in the province.

Northwest Territories

There was one mine opening and no mine closings in the Northwest Territories in 2002. After having been dormant for 16 years, the 1000-t/d CanTung tungsten mine re-opened in January, creating 175 mining jobs. The mine attained commercial production in April. First brought on stream in 1962, the mine was placed into care and maintenance in 1986 due to the collapse of tungsten prices as a result of Chinese tungsten flooding the world market. The re-opening of the CanTung mine, at an estimated capital cost of $10 million, resumes its position as North America's leading producer of high-grade, clean tungsten concentrates. Annual production, planned at 3000 t of tungsten concentrates, is sold under a three-year contract to the Sweden-based drill equipment maker Sandvik AB and Germany-based Siemens AG subsidiary Osram Sylvania Products. Sandvik and Osram Sylvania are among the world's leading producers of cemented carbides and consumers of tungsten concentrates. As of July 2002, the remaining mine life was estimated to be more than three years. In addition to owning the CanTung mine, North American Tungsten Corporation also owns the world-class MacTung deposit in the Northwest Territories. These assets represent the Western World's largest high-grade tungsten reserves and comprise some 15% of the world's proven tungsten resource base.

Nunavut

Nunavut was hit hard by two important mine closures in 2002, both base-metal mines. The 2300-t/d Nanisivik zinc-silver mine, located in northwestern Baffin Island, closed at the end of September, laying off some 200 miners. The closure was at least a year earlier than originally planned because of a decision to deplete economic ore reserves early in response to lingering unfavourable prices for zinc and silver. The mine first began production in 1976. The 2850-t/d Polaris zinc-lead mine also closed in September after 21 years of operation because of ore depletion, eliminating some 220 mine jobs. The Polaris mine, located on Little Cornwallis Island, was the world's most northern base-metal mine. Both the Nanisivik and the Polaris mines were important zinc producers for Canada and the only zinc mines north of the 60th parallel. Their closure has left Nunavut entirely without base-metal mines and has contributed to the continued decline in Canada's zinc production and reserves base. With no mine openings in 2002, the Lupin gold mine was the only mine remaining in Nunavut at the end of the year.

MINE EXPANSIONS AND EXTENSIONS

Despite continued low prices for many mineral commodities in 2002, at least thirteen significant mine expansion and extension projects, mostly at precious-metal and base-metal mines, were either started, continued or further expanded during the year (Table 2). One of these projects was located in Newfoundland and Labrador, one in Manitoba, three in Quebec, seven in Ontario, and one in the Northwest Territories. Two of these projects were new starts and the rest were continuations of existing programs, including seven world-class mines. Five expansion and three mine-life extension projects were concluded in 2002.

Newfoundland and Labrador

Iron Ore Company of Canada's $1.1 billion, six-year expansion and modernization program that started in October 1998 for its mine, concentrator and pellet plants in Labrador and Quebec continued at low gear throughout 2002 as iron ore prices stabilized. As a result, completion of a $361.5 million program to reactivate a pellet plant at Sept-Îles, Quebec, was again postponed. The plant, which was mothballed in 1982, was originally scheduled to re-open in 2002 with the creation of 140 long-term jobs. Iron ore prices improved significantly in the first half of 2003 and may allow owner Rio Tinto plc to review its decision to re-open the Sept-Îles plant. Better prices would be needed to put the overall investment program back on track.

Quebec

The US$218 million, two-phase expansion program that started in 1997 at the LaRonde gold mine in Quebec continued in 2002. Phase 1 of the expansion program, which included completion of the sinking of the Penna shaft to a depth of 7065 ft and the expansion of mill capacity to 4550 t/d from 3265 t/d in 2000, enabled record gold production of 260 000 oz in 2002, an increase of 11% over 2001 and a nearly 50% increase over 2000. Phase 2, started in 2001, has resulted in the completion of a further 40% mill capacity expansion to 6350 t/d in October 2002 and substantial underground development. Capital expenditures for expansion of the LaRonde mine totalled $61.4 million, compared with $36.3 million in 2001 ($68 million in 2000 and $69 million in 1999). The program will focus on the development of new ore and underground infrastructure in 2003 and 2004, leading to further production increases in those years. However, development glitches (mostly ore access and mill and mechanical problems) in 2002 and a massive rock fall in March 2003 caused gold production to be lower than expected in 2002 and in the first quarter of 2003, along with higher production costs. Consequently, gold production in 2003 is forecast to be lower than the 340 000 oz planned, at 300 000 oz, but would still be higher than in 2002. As of December 31, 2002, proven and probable reserves stood at 37.8 Mt (4.8 Mt higher than 2001) grading 3.347 g/t gold, 3.42% zinc, 0.375% copper and 69.776 g/t silver (containing 4.07 million oz of gold). In addition, the mine hosts an indicated resource of 588 000 t grading 3.9 g/t gold, 14.9 g/t silver, 0.17% copper and 0.55% zinc (containing 75 000 oz of gold), and an inferred resource of 20.9 Mt grading 5.9 g/t gold, 13 g/t silver, 0.33% copper and 0.08% zinc (containing 3.978 million oz of gold). With the gold contents of reserves and resources amounting to over 8 million oz, LaRonde is the largest gold deposit in Canada and one of the largest in the world. Exploration and development work will continue at the mine with a focus on Zone 7 and Zone 20 North, and at El Coco, Goldex and the recently acquired nearby Lapa property.

At the Niobec niobium mine near Chicoutimi, a $15.7 million, two-phase capital program that began in 1998 to develop deep ore and expand production capacity was completed in 2002. In 2002, capital expenditures amounted to $2.4 million, compared with $2 million in 2001 ($6.2 million in 2000 and $3.8 million in 1999). Capital expenditures in 2003 are estimated at $3.8 million, mainly for underground infrastructure development and the construction of a new tailings pond. During 2002, mill capacity was increased to 3400 t/d from 2700 t/d in 2001 (2400 t/d in 2000). Production in 2002 was estimated at about 3000 t of niobium. As of December 31, 2002, proven and probable reserves stood at 23.8 Mt grading 0.65% Nb_2O_5, a 26% increase in the Nb_2O_5 content over 2001 (18.2 Mt grading 0.68% Nb_2O_5), thereby extending the mine life to at least 18 years at the current rate of production. Niobec is the only producer of niobium and ferroniobium in North America and is one of three important producers in the world, constituting about 15% of the world market for niobium.

In 2002, the Troilus gold mine near Chibougamau expanded its mill capacity to 16 000 t/d from 10 000 t/d in

2001 and increased gold production to 164 900 oz (from 162 000 oz in 2001). The production increase was the result of a higher throughput that more than offset the disadvantages caused by the mining of a lower-grade ore and a lower gold recovery rate. Cash production costs were higher at US$247/oz (US$232/oz in 2001), due mainly to the higher mining costs associated with higher stripping requirements. The newly developed, small, but higher-grade, J-4 zone began production in the fourth quarter, supplementing mill feed that previously came solely from the "87" main pit. Total capital expenditures for new ore development and mill expansion amounted to $8.3 million in 2002. A revised proven and probable reserves estimate for December 31, 2002, of 42.5 Mt grading 0.9 g/t gold (1.04 million oz) and 0.09% copper (32 000 t), effectively doubled a previous estimate of gold and copper reserves of 55 000 oz and 18 000 t, respectively, thus doubling the mine life to eight years and pushing its closure date to 2010.

Ontario

A $220 million expansion program that started in 2000 at the Lac des Iles palladium mine near Thunder Bay was completed in 2002. A new concentrator, which was completed in June 2001, increased the mine's ore throughput capacity more than sixfold to 15 000 t/d from 2400 t/d. Although a number of milling and concentrator circuit-related problems have reduced throughput performance and recovery to below the designed rates in 2001, most of the problems have since been corrected and annual palladium production from the mine increased to 220 000 oz, or about 5% of the world's production of palladium in 2002. During 2002, exploration continued in the faulted extension of the Main High Grade zone, dubbed the "Offset High Grade" zone, at depth. This zone was discovered in 2001. As of December 31, 2002, ore reserves at the mine were estimated at 88 Mt grading 1.53 g/t palladium (4.3 million oz), 0.17 g/t platinum, 0.12 g/t gold, 0.06% copper and 0.05% nickel. Measured and indicated resources stood at 65.9 Mt grading 1.58 g/t palladium (3.3 million oz), 0.17 g/t platinum, 0.11 g/t gold, 0.05% copper and 0.05% nickel. A further 73 Mt were classified as inferred, grading 1.57 g/t palladium, 0.15 g/t platinum, 0.10 g/t gold, 0.05% copper and 0.05% nickel. The mine life, based on current reserves and rate of production, will be at least 16 years from the start of 2003. At full production, beginning in the second half of 2003, annual mine output is expected to be 250 000 oz of palladium, 23 000 oz of platinum, 18 000 oz of gold, 6 million lb of copper and 2 million lb of nickel. The average cash cost over the mine life, net of by-product credits and royalties, is estimated at US$200/oz of palladium. The mine currently employs a work force of 275, compared with 130 prior to the expansion. The Lac des Iles mine is Canada's only primary palladium mine.

The production expansion program at the Musselwhite mine in northwestern Ontario that began in 2001 was completed in 2002, with the mill capacity increased to 4000 t/d from 3300 t/d and the installation of an underground jaw crusher and conveyors to bring ore to the surface from the 460-m level. As well, the tailings treatment capacity was increased. However, due to unexpected production interruptions and delays in commissioning the new underground crusher and conveyor system, gold production was lower in the year at 209 600 oz, compared to 233 800 oz in 2001. In 2003, production is forecast to be 236 450 oz of gold from 1.436 Mt of ore throughput. The mine plan includes seven ore deposits: T Antiform, OP, PQ, Esker, West Anticline, Intraformational and the West Zone. As of December 31, 2002, proven and probable reserves stood at 8.11 Mt grading 5.4 g/t gold (1.419 million oz). Measured and indicated resources were 3.108 Mt grading 7.1 g/t gold. In addition, there were 2.245 Mt of inferred resources grading 7.6 g/t gold. Based on current reserves, the mine is expected to last until 2011.

Continued successes in mine-site exploration and development since the re-opening of the Red Lake gold mine at Balmertown in 2000 have again led to an upward adjustment to the mine's ambitious mine expansion and extension program in 2002. The Red Lake mine produced 85 115 oz of gold in 2000 in its first year of resuming production. In 2002, gold production, mainly from the High Grade Zone (HGZ), was a record 525 000 oz (503 385 oz in 2001) at a cash cost of US$65/oz (US$59/oz in 2001), more than double the original feasibility study's forecast annual production of 240 000 oz (at a cash cost of US$88/oz), maintaining the Red Lake mine as the largest gold-producing mine and one of the two lowest-cost gold mines (the other being the Eskay Creek mine in British Columbia) in Canada. The mine's High Grade Zone represents the richest gold deposit in the world. For 2003, gold production is forecast at over 500 000 oz at a cash cost of less than US$70/oz. As of December 31, 2002, proven and probable reserves in the High Grade Zone were 1.775 Mt grading 80.57 g/t (2.35 oz/short ton), for a total of 4.594 million oz, a 21% increase in gold content over 2001. In addition, proven and probable reserves in the sulphide zones totalled 1.368 Mt grading 12 g/t (0.35 oz/st) gold, or 533 000 oz. The combined measured and indicated resource also increased to 957 000 t grading 22.28 g/t (0.65 oz/st) gold. In addition, the mine hosts an inferred resource of 748 000 t grading 39.43 g/t (1.15 oz/st) gold. Although the mine has just completed a major expansion program in 2002 and is continuing with a $12 million exploration program to expand reserves and resources, it is poised for another major expansion. In February 2003, owner and operator Goldcorp Inc. announced a new US$85 million program to expand the production capacity at the Red Lake mine over the next three years. The expansion plan will include a new shaft to increase the hoisting capacity by more than 200% to 4000 st/d, of which 2500 st/d could be ore capacity.

At the Kidd Creek copper-zinc-silver mine in Timmins, the development of Mine D, a $640 million deep development program to extend the mine life, continued in 2002. The two-stage development continued to extend the section between 2100 m (6800 ft) and 3100 m (10 000 ft) for access to an additional 10 Mt of reserves and 14.1 Mt of resources. While Stage 1 of the development will take the mine to the 2700-m level, Stage 2 will extend the mine down to 3100 m, making Kidd Creek the deepest base-metal mine in the world. Stage 1 involves the development of 15.7 Mt of ore grading 2.82% copper, 5.74% zinc and 58 g/t silver, whereas ore for Stage 2 development is estimated at 10.5 Mt grading 2.20% copper, 5.27% zinc and 97 g/t silver. As of December 31, 2002, total proven and probable reserves at the Kidd Creek mine, including Mine D, were 23.7 Mt grading 2.11% copper, 6.30% zinc and 66.46 g/t silver. The mine also hosted a small indicated resource of 100 000 t grading 2.96% copper, 6.79% zinc and 50 g/t silver, and an inferred resource of 14.1 Mt grading 3.40% copper, 4.90% zinc and 91 g/t silver, which came essentially from Mine D. In 2002, the overall cash operating costs at the Kidd Creek mine averaged US$0.62/lb of copper, net of by-product credits. Work has begun to sink a new underground shaft from about 1460 m to 3100 m. Production from Mine D is scheduled to begin in 2004 and is expected to reach 550 000 t in 2005. Ore production from Mine D will increase the overall ore throughput from the Kidd Creek mine to approximately 2.4 Mt from the 2002 rate of 2 Mt. The Mine D project at Kidd Creek is by far the largest deep ore development and mine extension project in Canada. It is expected to extend the overall mine life of the Kidd Creek mine beyond 10 years.

In the Sudbury Basin, Inco Limited's three production expansion and mine-life extension programs for its nickel-copper operations continued throughout 2002. At the Creighton mine, the first phase of the US$125 million Creighton Deep project, which began in 2001, involves the development of proven reserves of 2.8 Mt grading 3.45% nickel and 2.97% copper between the 7400-ft and 7660-ft levels from 2001 to 2013. Production from ore developed in Phase 1 already began in 2001. In the second phase, development will extend down to the 8180-ft level to mine some 3.1 Mt of probable reserves grading 3.62% nickel and 3.25% copper between 2005 and 2019. When fully on stream, annual production of the mine is expected to be 10 900 t of nickel, 9500 t of copper and 28 000 oz of platinum group metals. The deep development project at Creighton is one of the company's most significant mine extension and expansion projects in Ontario in recent years. The Creighton mine, discovered in 1856 and brought on stream in 1901, celebrated a century of continuous production in 2001. It is Inco's oldest operating mine and the deepest nickel mine in the world. In 2002, Inco took a decision to deepen the Garson mine in Sudbury by announcing a $60 million (US$43 million) capital program to access ore located between 1360 and 1550 m below surface. The program, substantially completed in the year, is expected to extend the mine life at Garson from one year to nine years. Production is also expected to increase from some 1900 t/d to 2100 t/d. At the McCreedy East mine, a four-year, $46 million (US$33 million) capital program initiated in June 2000 to develop a nearby newly discovered high-grade nickel deposit reached the halfway mark in 2002. It involves mine development of the Main and adjacent West orebodies containing 8 Mt grading 1.88% nickel, 0.84% copper and 0.91 g/t platinum group metals. Mine production is expected to increase to 4350 t/d from the current 2700 t/d when full production is reached in late 2004, with metal production of 22 million kg (48 million lb) of nickel and 42 million kg (92 million lb) of copper annually, up from the current 13 million kg (29 million lb) of nickel and 39 million kg (82 million lb) of copper. The mine has other mineral zones and has the potential to extend its current life of 15 years. The McCreedy East mine, which also underwent a $194 million expansion between 1997 and 1999, is one of Inco's four key mines in Ontario and one of the company's lowest-cost mines in the province. The other three are the Creighton, Copper Cliff North and Copper Cliff South mines. In 2002, Inco's capital development expenditures for expansion and mine-life extension of its Sudbury mines totalled some $90 million ($97 million in 2001).

Manitoba

A US$48 million ($70.4 million) capital program that began in 2001 to deepen the Birchtree nickel mine near Thompson in order to expand production and extend the mine life was completed in 2002. The two-year program has deepened the mine and increased the daily production capacity to 3175 t from 1635 t while reducing costs by 25%. Capital investment in 2002 is estimated at $35 million. The mine is expected to reach full production in 2004. A redesigned mine development plan, by a joint Inco and union team, could see further lowering of costs and accelerated cash flow. As well, deepening the mine has increased ore reserves to 13.6 Mt grading 1.79% nickel. The Birchtree mine operated from 1966 to 1977, returning to production most recently in 1989. Inco is also studying the deepening of its Thompson 1-D orebody and is re-surveying the entire Thompson nickel belt. These activities are all part of Inco's strategy to focus on discovering new mineralization at or near existing mines and previously known deposits.

Northwest Territories

The original mining plan at the Ekati diamond mine in the Lac de Gras area involving five pipes (Panda, Koala, Misery, Sable and Fox) was revised since the discovery of several higher-grade pipes on the property between 1993 and 1999. Consequently, a new mine plan took into consideration the new pipes that are closer to the central mill site, such as the Koala North, Lynx, Jay, Beartooth and Pigeon pipes. Priority was given to the development of the Misery pipe as the Ekati mine's second open-pit operation, followed by the Koala North underground operation. With diamond production from the Misery pipe beginning in December 2001 and from Koala North commencing in August 2002, as well as from other pipes in the planned sequence, production capacity at the Ekati mine is gradually increasing towards the planned 18 000-t/d level for 2008 from the current 9000 t/d.

Others

In addition to the above major projects, several mines across Canada have also undergone relatively significant expansion or mine-life extensions in 2002. In Quebec, significant deep drilling and development work was carried out at the Doyon Division gold mines near Cadillac. Capital expenditures totalled $8.1 million in 2002, slightly higher than in 2001. Proven and probable reserves at year-end 2002 stood at 8 Mt grading 5.3 g/t gold (1.4 million oz). As a result of the increased deep drilling, measured and indicated resources were increased to 1.9 Mt grading 3.6 g/t gold and inferred resources amounted to nearly 6.3 Mt grading 5.2 g/t gold. At the Sleeping Giant gold mine north of Amos, the newly discovered Zone 8 was extended by more than 150 m towards the south and the presence of the vein at depth was confirmed in 2002. In Manitoba, as part of the $400 million 777 project to develop two new mines (the Chisel North mine and the 777 mine), expansion of the Flin Flon concentrator and the new 777 shaft were completed in 2002. In Alberta, a decision to postpone the development of the Cheviot coal project near Hinton has also led to the need for the further postponement of a planned closure at the nearby Luscar coal mine to the end of 2003. The Eskay Creek mine had its best production year despite lower grades and a strike at one of the mine's key third-party smelters. Gold production in 2002 increased to 359 000 oz, a 12% increase over 2001, as cash costs decreased by 18% to US$40/oz, the lowest gold mine production cost in Canada. To mitigate the impact of the third-party smelter strike that began in July 2002, the mine optimized its milling capacity, increasing throughput (by 12%), re-sequencing the mining efforts to source higher-grade ore, and arranging for increased sales to its other main smelter. As of December 31, 2002, proven and probable ore reserves were 1.3 Mt grading 34.217 g/t (0.998 oz/st) gold for 1.43 million oz of gold. The reserves also contain 64.4 million oz of silver.

Overall, in addition to new mine developments, the major mine expansion and extension programs described above continue to indicate that, due to difficult times in recent years brought about by lingering weak metal prices and financing difficulties, mining companies in Canada have been concentrating their financial resources on mine-site exploration instead of off-site exploration and the development of new mines. The results also show that these companies were able to continue to discover new ore at existing mines. The successes of such discoveries and follow-up developments have enabled the mines to extend their lives and expand production, which in turn have enabled the mines to reduce production costs and to stay competitive and economically viable. Although most expansion or extension projects seldom result in large increases in new mining jobs, over 150 new jobs were created from such projects in 2001 and 2002, most significantly at the LaRonde and Lac des Iles mines, and more than 300 mine jobs were saved at a number of mines, notably at the Garson, Birchtree and Luscar mines, which otherwise would have closed or been at risk of closing. These events were sufficient to mitigate job losses due to production cutbacks and production losses due to other reasons at many gold, base-metal, uranium and coal mines in 2002.

IMPACT

In 2002, the small new mine (Mishi) brought on stream some 200 t of daily ore production capacity and created some 10 mining jobs, the smallest amount of daily ore capacity and lowest number of new jobs from new mine openings in more than a decade. However, the eight mines that re-opened resulted in 16 000 t/d of ore capacity and nearly 1200 jobs. In contrast, almost 18 500 t/d of ore capacity and over 1600 jobs were lost from six mine closures and three production suspensions, resulting in net losses of nearly 1500 t of daily ore capacity and 330 direct mining jobs. These losses, however, represented some of the smallest net losses in recent years. The largest contributors to the overall job loss were the Ruttan, Polaris, Nanisivik, Bousquet and Cluff Lake mines, which together constituted 72% of the total net job loss. The same five mines also accounted for 77% of the net capacity loss.

In addition, production losses and cutbacks have again resulted in significant job losses during the year, especially at gold, base-metal, uranium and coal mines. In 2002, such job losses were estimated at less than 200, a level similar to 2001. This, however, makes 2002 the sixth consecutive year of job losses due to production losses and cutbacks at producing mines across Canada.

Mine openings ensure immediate access to new or redeveloped sources of economic mineral supply, new production capacity and capability, and new mining jobs. They also reflect Canada's mine-building ability and its attractiveness in the face of global competition and globalization. Although the number of mine openings equalled the number of mine closings in 2002, the recent trend in which base-metal mines are fewer or lacking in both number and size has persisted and has reached the lowest level in more than a decade. However, gold, uranium and tungsten mine re-openings during the year provided desperately needed additions to Canada's total metallic mineral production capability. Overall, while production from the small new gold mine in 2002 is expected to add only

7000 oz of gold annually (Table 3) to Canada's total gold production, mine re-openings in 2002 will have a more beneficial impact on the regions across Canada. The re-opening of the Beaufor, Sigma Lamaque and Joe Mann gold mines in the Abitibi Greenstone Belt of Quebec provided a much-needed boost to mining in this depressed region where mine employment and mining capacity losses continued to mount in recent years as a result of mine closures continuing to outnumber mine openings since 1999. The re-opening of the Eagle Point uranium mine in northeastern Saskatchewan not only revived mining in the Rabbit Lake uranium camp, which had been dormant since 1999, but also offset the negative impact of the closure of the Cluff Lake uranium mine in northwestern Saskatchewan in 2002. In British Columbia, the re-opening of the Myra Falls zinc-copper mine revived the only current metal mining camp on Vancouver Island. As well, the re-opening of the CanTung tungsten mine in the Northwest Territories near the Yukon border has put Canada back on the world map as an important tungsten producer.

Table 4 shows that new mines and mine re-openings in 2002 have added 10.34 t (333 000 oz) of gold, 23.25 t (750 000 oz) of silver, 15 700 t of copper, 5000 t of nickel, 60 000 t of zinc, 2700 t (6 million lb) of U_3O_8 and 3000 t of tungsten to Canada's total annual mineral and metal production. They also added over 81.41 t (2.62 million oz) of gold reserves, 334.9 t (10.76 million oz) of silver reserves, 116 500 t of copper, 10 000 t of nickel, 5.53 Mt of zinc, 47 000 t of lead, 9000 t of uranium and 10 000 t of WO_3 to Canada's total reserves of these metals and minerals. Except for gold and tungsten, reserves from mine openings in 2002 would be insufficient to replenish depleted mine reserves due to production or to stem the recent and alarming decline in Canada's once mighty base-metal production capability.

NEW DEVELOPMENTS EXPECTED TO BECOME MINES IN 2003

Preliminary estimates, based on mine development activities in 2002 and in the first half of 2003, indicate that three mines, two of which will be new mines, could come on stream in 2003. Among the most promising new mines are Melford (gypsum) in Nova Scotia and Diavik (diamonds) in the Northwest Territories. In fact, the world-class Diavik mine, developed at a total cost of $1.2 billion, began diamond production in February 2003. In addition, the McCreedy West mine redevelopment project in Ontario is expected to begin nickel production from its Phase 1 mining program in the second half of 2003.

In addition, several existing mine expansion and extension projects, as well as new ones that were initiated in 2002, are expected to continue in 2003 with others likely to be announced during the year. These mine expansions and mine-life extensions, together with new mine developments, are central to sustaining mine production in Canada. In the face of still weak prices for a number of minerals and metals and without having to resort to significant layoffs, mine expansion remains an effective option by which production costs can be lowered and productivity increased at an existing mine. Such an option is especially beneficial for mines that have significant recent new mine-site ore discoveries, for example, the LaRonde, Troilus and Niobec mines in Quebec; the Red Lake, Musselwhite, Lac des Iles, Kidd Creek, Creighton and McCreedy East mines in Ontario; the Birchtree mine in Manitoba; and the Ekati mine complex in the Northwest Territories, all of which have been discussed above, as well as many others that are still in the planning stages.

OUTLOOK

With the exception of zinc and lead, precious-metal and base-metal prices strengthened in 2002 in response to increased global demand, setting the stage for a significant metal price recovery and acting as a catalyst for exploration and new mine development across Canada. Both exploration spending and capital investment in new mine developments, mine redevelopments for re-opening, and expansions and mine-life extensions were up in 2002 compared with 2001. While total exploration expenditures increased to $573 million in 2002 from $513 million in 2001, total mine complex development expenditures dropped to $2.1 billion from $2.6 billion in 2001, and exploration (less than $140 million) and capital development expenditures (around $260 million) on base metals remained at low levels in 2002, as in 2001. Base-metal mine reserves, particularly copper and zinc, reached alarming levels in 2002, bringing Canada's mine production capability for these metals to its lowest level since 1981. This has come as no surprise as closures of larger base-metal mines continued to outnumber openings. As well, the recent decline in mine openings has resulted in shrinking the number of principal producing metal mines in Canada to below 70 in 2001 and 2002, the lowest level in more than two decades, continuing the erosion of Canada's base-metal and overall metal mine production capabilities – a major feedstock for the downstream economy. With the exception of nickel, Canada's traditionally strong base-metal mining, especially of copper and zinc, has fallen prey not only to global competition, but also to weak prices over the years, resulting in years of neglect in base-metal exploration and development. Prior to 1998, Canada ranked third in the world in copper production. As the result of a continuous decline in mine production and reserves, copper production in Canada had fallen to sixth place by 2002. The situation for Canadian zinc is worse. In 2002, Canada slipped again in world rank for zinc production, dropping to fourth from the number one position it held prior to 1997. Sustained increases in both exploration and mine development activities and expenditures are needed to enable Canada to rebuild its lost base-metal production capabilities and to regain its lost world market shares.

While the outlook for metals in general has brightened, many Canadian mines are aging and production costs are increasing. To better prepare and position themselves for the next up-cycle in metals and minerals, Canadian companies need to continue to find innovative ways to stay competitive in the global market. In recent years, Canadian companies have acted more swiftly to market conditions by closing down high-cost mines, consolidating operations, cutting back on production and work force, imposing or extending temporary shut-downs, revamping mining methods, introducing innovations, expanding production capacity, or postponing mine openings and developments, as well as undertaking combinations of these and other measures. However, many mines appear to have reached the end of their mine lives or their limits for further technical or economic improvements and the costs of further improvement would likely outweigh the anticipated benefits. In these cases, mine closure or temporary shut-down become inevitable options. This situation has also resulted in accelerated production and premature mine closures, such as in the cases of the Sullivan mine in 2001, the Nanisivik and Ruttan mines in 2002, and Obed Mountain and Magnola in 2003.

Currently, the most damaging factor for mine development and mine openings in Canada is still the economic uncertainty in the United States, Japan and Western Europe, although the situation has improved since 2001. Since the current economic slowdown in the United States, which set in during the second half of 2000, there have been no convincing signs of sustained economic recovery. On the contrary, the budget deficit in the United States is mounting. It reached US$450 billion in 2002 and the forecast for 2003 is higher. This has affected mineral trade and demand for metals in North America and Western Europe. As well, the long-awaited economic recovery in Japan, since the metal downturn that started in 1997, is slow in coming, although there were positive signs in 2002.

The only bright sign has been a steadily strong demand from China for key industrial minerals and metals. In fact, the strong demand from China has offset much of the overall negative impact from the American and Japanese economic malaise and has helped to strengthen key industrial metal prices such as nickel, copper and iron prices and to prevent the weakening of zinc and lead prices. While the renewed International Monetary Fund-European Central Bank agreement to limit gold sales by central banks and the weak U.S. dollar provided a boost to gold prices, the recent success in China's gold liberalization policy, resulting in the launch of the Shanghai gold market and stock exchange in 2001 and in allowing private ownership of gold bullion in 2002, has also helped strengthen the world gold price, which reached over US$347/oz at year-end 2002 and continued its upward climb in the first half of 2003. Although the slow economic recovery in the United States will continue to have a dampening effect on the growth in demand for industrial metals and thus the price recovery of these metals, as long as the U.S. dollar remains weak, gold prices can be expected to remain strong. The SARS outbreak in March and throughout the second quarter of 2003 has put considerable doubt on the momentum of the increasing demand for metals from China. However, by the end of June, news on the containment of SARS in China had revived hopes that demand for metals from this country will likely continue its upward trend and key metal prices, especially for nickel, copper, zinc and iron ore, will continue to recover in the foreseeable future. As a result, many new mine development and redevelopment projects in Canada that were shelved since 1997, and that were subsequently revived for development since early 2000 but were again negatively affected and quietly postponed, will again be revived.

As a result of the successful substitution of platinum for palladium in catalytic converters in the automobile industry since 2001, palladium prices have plummeted and platinum prices have shot up considerably, quadrupling that of palladium since 2002. The auto industry is now contemplating a switch back to palladium. As the U.S., Japanese and European economies recover, albeit slowly, increases in automobile output will continue to boost the use of either platinum or palladium and, in fact, the entire platinum metals group, which will continue to fuel exploration and development of platinum group metal (PGM) projects. In Canada, PGMs are commonly associated with nickel deposits. As a result of favourable prices, there have been an increasing number of discoveries of high-grade PGM deposits, notably in Ontario and Quebec.

As for other minerals and metals that are most likely to affect the outcome of mine developments and mine openings and closures in Canada, diamonds, coal and uranium will continue to play an important role. While the outlook for coal is mixed, the outlooks for both diamonds and uranium remain bright. Although demand for thermal coal has declined in recent years due to severe global competition and increased environmental restrictions, metallurgical coal use has strengthened as a result of increased demand for steel since 2001. The trends are likely to continue throughout 2003 as global industrial demand has shown signs of recovery after SARS. As well, increased demand for cleaner energy, especially since the California power shortage in 2001, has put upward pressure on nuclear reactors and hence uranium prices, thereby increasing the price outlook for uranium. Strong demand for high-quality gem diamonds continues to fuel exploration for and development of diamond projects in Canada. With two world-class diamond mines, namely, Ekati and Diavik, in production, and the Snap Lake, Victor and Jericho projects at the environmental permitting stage, Canada is poised to move up among the top diamond producers in the world. Should the Snap Lake, Victor and Jericho projects be developed into mines as planned, Canada is expected to become the third largest diamond producer in the world by 2007. With numerous existing and new discoveries, Canada's diamond future is bright.

Mine openings are expected to again be outnumbered by mine closings in 2003 due to some delays and postponements in planned mine openings. However, given the overall improved demand and price outlook for key industrial minerals and metals, the prospects for mining, mine re-openings and new mine developments that have been committed for production and those that are moving toward the development stage have greatly improved.

Notes: (1) Information in this review, based mostly on company reports and communications with companies, was current as of June 30, 2003. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002cmy_e.html.

Note to Readers

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TABLE 1. MINE OPENINGS AND CLOSINGS IN CANADA, 2002

Province/ Territory	New Mines			Mines Re-Opened			Mines Suspended			Mines Closed		
	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals
Newfoundland and Labrador	–	–	–	–	–	–	–	–	1	–	–	–
Quebec	–	–	–	3	–	–	1	–	–	1	–	–
Ontario	1	–	–	1	1	–	–	–	–	–	1	–
Manitoba	–	–	–	–	–	–	–	–	–	–	1	–
Saskatchewan	–	–	–	–	–	1	–	–	1	–	–	1
British Columbia	–	–	–	–	1	–	–	–	–	–	–	–
Northwest Territories	–	–	–	–	–	1	–	–	–	–	–	–
Nunavut	–	–	–	–	–	–	–	–	–	–	2	–
Canada, total by commodity group	1	–	–	4	2	2	1	–	2	1	4	1
Total Canada		1			8			3			6	

Source: Natural Resources Canada, based on company reports.
– Nil.

TABLE 2. MINE OPENINGS, RE-OPENINGS, EXPANSIONS, EXTENSIONS, SUSPENSIONS AND CLOSURES IN CANADA IN 2002

Mining Project/Remarks	Location	Province/ Territory	Capacity	Employment During Mine Life	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Company
			(t/d)					
NEW MINES								
Precious Metals								
Mishi	Wawa	Ont.	200	(e) 10	August	O/P	Gold	River Gold Mines Ltd.
Remarks: Gold production at the small Mishi mine began in August 2002. Initial open-pit mining produced 2800 oz of gold from 20 000 t of ore grading 4.4 g/t gold. By year-end, an additional 26 500 t of ore grading 3.8 g/t gold was stockpiled at the Eagle River mill. Annual gold production is estimated to be about 7000 oz. As of December 31, 2002, proven and probable reserves stood at 210 000 t grading 3.1 g/t gold, sufficient for three years of production at a stripping ratio of less than 1:1. The capital cost to production is estimated at less than $1 million. The mine will operate on a seasonal basis. Beneath the open pit is an indicated resource of 1 043 000 t grading 5.1 g/t gold. River Gold Mines Ltd. intends to develop this underground resource for production over the next two years. The Mishi mine is part of the Mishi-Magnacon Complex. The company is planning a $3 million dewatering, drilling and development program at the Magnacon property, in which the Magnacon mine produced some 34 000 oz of gold between 1989 and 1990.								
RE-OPENINGS								
Precious Metals								
Beaufor	Val-d'Or	Que.	1 100	(e) 100	January	U/G	Gold	Richmont Mines Inc. and Louvem Mines Inc.
Remarks: The mine was first developed for production in January 1996. Mining was suspended in August 2000 due to pillar stability problems. Following completion of underground work to secure the mine, production resumed in January 2002. Gold production in 2002 was 56 065 oz at a cash cost of US$163/oz. Gold recovery reached 99%. As of December 31, 2002, proven and probable reserves at the mine stood at 1 012 400 t grading 7.54 g/t gold, for a total of 246 000 oz. In addition, there were some 730 280 t of mineral resources grading 7.20 g/t gold (or 171 000 oz). Based on mineable reserves and production rate at the start of 2003, the remaining mine life is estimated at 4-5 years.								
Sigma-Lamaque	Val-d'Or	Que.	5 000	(e) 105		O/P	Gold	McWatters Mining Inc.
Remarks: Redevelopment work and expansion of milling capacity from 3000 t/d to 5000 t/d at the Sigma-Lamaque Complex were completed with production resuming on November 27, 2002, at a capital cost of $34 million. Commercial production at the 72% mill capacity level was reached on April 1, 2003. On April 3, 2003, McWatters Mining Inc. also completed the acquisition of the remaining 40% interest in the Complex that was held by SOQUEM INC. and the purchase of the East Malartic milling facilities, including 60 km^2 of mining properties, from Barrick Gold Corporation. From November 27, 2002 to March 31, 2003, the mine produced 20 392 oz of gold at a gold recovery rate of 95%. Production for 2003 is expected to reach 100 000 to 110 000 oz of gold at a cash operating cost of US$200-$210/oz. Proven and probable ore reserves at the end of 2002 were 14.965 Mt grading 2.61 g/t gold, or 1.258 million oz, sufficient for at least another 10 years of mine life at the current rate of production. Measured and indicated resources stood at 8.183 Mt grading 3.60 g/t gold (956 000 oz). In addition, an inferred resource stood at 11.505 Mt grading 4.91 g/t gold (1.815 million oz). The Sigma mine began production in March 1937. McWatters purchased the mine from Placer Dome Inc. in September 1997. In the third quarter of 2000, the underground operation was closed, followed by the suspension of production at the open-pit operation in February 2001, both due to high costs.								
Joe Mann	Chibougamau	Que.	1 170	175	March 31	U/G	Gold, copper	Campbell Resources Inc.
Remarks: Production was suspended at the Joe Mann gold mine near Chibougamau between November 2000 and March 2002 due to high costs. A 17-month exploration program and a 4-month redevelopment program that began in November 2001 by Campbell Resources Inc., following a three-way merger with MSV Resources Inc. and GéoNova Explorations Inc. on June 30, 2001, have resulted in a significant reduction in operating costs. Production at the mine resumed at the end of March 2002, with expected yields of 56 000 oz of gold and 1.2 million lb of copper in 2002, with gold production at a cash operating cost of US$200/oz. Total capital investment to redevelop the Joe Mann mine for production is estimated at $10 million. At the start of production at the end of March 2002, proven and probable reserves were 1 228 300 t grading 10.41 g/t (0.3038 oz/st) gold and 0.265% copper.								
Macassa	Kirkland Lake	Ont.	(e) 900	(e) 50	May 14	U/G	Gold	Kirkland Lake Gold Inc.
Remarks: In June 1999, production at the Macassa gold mine near Kirkland Lake, Ontario, was suspended by the previous owner, Kinross Gold Corporation, due to low gold prices. On December 14, 2001, Foxpoint Resources Ltd. acquired the mine and mill along with four contiguous properties from Kinross and subsequently re-opened the mine in May 2002. The cost of re-opening is estimated to be about $1 million. In October 2002, the company changed its name to Kirkland Lake Gold Inc. While production since the start of mining in May came mainly from surface ore stockpiles, underground production from Shaft No. 3 was initiated in January 2003. In February 2003, a significant high-grade mineralized zone dubbed "D zone" was discovered about 500 ft from Shaft No. 3. While most ore zone structures in the Kirkland Lake Camp are east-west trending, this zone is north-south trending. The company has since been able to expand on this new D zone. In early March, underground production was suspended due to the failure of the pillar between an existing ore pass and Shaft No. 3. As of January 8, 2003, proven and probable reserves at the mine were estimated at 725 750 t grading 15.42 g/t gold (359 800 oz). Measured and indicated resources totalled 2.783 Mt grading 10.62 g/t gold (944 700 oz). In addition, there was an inferred resource of 407 300 t grading 9.25 g/t gold (121 200 oz). Gold production is forecast to be 50 000 to 70 000 oz in 2003.								
Base Metals								
Gertrude	Sudbury	Ont.	(e) 1 600	(e) 120	October	O/P	Nickel, copper, platinum group metals (PGM)	Inco Limited

Remarks: The Gertrude mine began limited production in 1997, followed by a shut-down in 1998 and 1999, and re-opened for commercial production in 2000. Production was again suspended in 2001 and resumed in October 2002. The cost of re-opening is estimated to be $1 million. Annual ore throughput is estimated to be 500 000 t. The open-pit reserves are expected to last beyond 2004. Mining is carried out entirely through contract mining. The Gertrude open pit is a flywheel operation subject to standby at any time.

Myra Falls	Campbell River	B.C.	4 000	360	March	U/G	Zinc, copper, gold, silver	Boliden AB

Remarks: Production at the Myra Falls operations first began at the Lynx open-pit mine in December 1966, followed by underground production at the Myra mine in 1972, at the Lynx mine in 1975 and at the H-W mine in 1985. Both the Lynx and Myra mines have since been mined out. Current production comes from the H-W and the Battle and Gap zones, which were discovered in 1979 and 1991, respectively. In the first quarter of 1998, Boliden acquired the Myra Falls operations by purchasing Westmin Resources Limited and created Boliden Westmin (Canada) Limited to oversee the operations. In mid-December 1998, production at Myra Falls was temporarily suspended to address challenging ground conditions in the Battle zone and full production resumed in March 1999. Operation again was suspended in December 2001 but resumed in March 2002 after the implementation of an action plan that will lower costs and make production considerably more efficient. As of December 31, 2002, proven and probable reserves at the Myra Falls mine were 8.267 Mt grading 1.25% copper, 6.70% zinc, 0.57% lead, 1.22 g/t gold and 40.51 g/t silver, sufficient to support production at the current rate for another six years. The mine also hosts 4.579 Mt of measured and indicated resources grading 1.32% copper, 7.41% zinc, 0.7% lead, 1.72 g/t gold and 61 g/t silver.

Other Minerals/Metals

Eagle Point	Rabbit Lake	Sask.	(e) 600	(e) 150	August	U/G	Uranium	Cameco Corporation

Remarks: Mining resumed at the Eagle Point uranium mine at Rabbit Lake, Saskatchewan, in June 2002 followed by uranium production in August. The restart of mining, estimated at a cost of over $5 million, however, did not go as smoothly as planned due to equipment problems and poor ground conditions. In 2002, the mine produced 98 227 t of ore grading 0.76% U_3O_8, yielding 1.1 million lb of U_3O_8, which was less than the planned amount of 3 million lb. In 2003, the mine is expected to produce 6 million lb of uranium from its remaining reserves of about 17.6 million lb U_3O_8. Prospects for additional reserves are being explored where extensions to known orebodies have been identified.

CanTung	Cantung	N.W.T.	1 000	175	January 21	U/G	Tungsten	North American Tungsten Corporation Ltd.

Remarks: Tungsten production resumed at the CanTung mine in the Northwest Territories on January 21, 2002, after a 16-year production suspension. The mine was shut down due to the collapse of tungsten prices as a result of market flooding by imports from China. The re-opening of the CanTung mine resumes its position as the Western World's largest producer of high-grade, clean tungsten concentrates. Annual output is planned at 3000 t (300 000 metric tonne units or mtu, where 10 kg = 1 mtu) of tungsten concentrates. Sweden-based drill equipment maker Sandvik AB and Germany-based Siemens AG subsidiary Osram Sylvania Products, Inc. agreed to purchase the mine's full production for three years and provided a $4.5 million loan to cover part of the start-up costs. Sandvik and Osram Sylvania are among the world's leading producers of cemented carbides and consumers of tungsten concentrates. The CanTung mine first began production in 1962 and was placed into care and maintenance in 1986. The capital cost for re-opening the mine in early 2002 is estimated at $10 million. As of December 2002, proven and probable ore reserves were estimated at about 560 000 t grading 1.82% WO_3, sufficient to maintain full production for more than three years. In addition to owning the CanTung mine, North American Tungsten Corporation Ltd. also owns the world-class MacTung deposit in the Northwest Territories. These assets represent the Western World's largest proven high-grade tungsten reserves and comprise some 15% of the world's proven resource base.

EXPANSIONS AND EXTENSIONS

Precious Metals

LaRonde	Val-d'Or	Que.	6 350	500	1997-2004	U/G	Gold, zinc	Agnico-Eagle Mines Limited

Remarks: In 2002, Agnico-Eagle Mines Limited completed the expansion of the production capability of its LaRonde gold mine near Val-d'Or, Quebec, with mill capacity increased 40% from 4530 t/d to 6350 t/d and gold reserves increased by 23% from 3.3 million oz in 2001 to 4 million oz at a capital cost of $61.4 million. When added to the inferred resources of 4 million oz, this makes LaRonde the largest gold deposit in Canada and one of the largest in the world. The mine also saw record gold production of 260 000 oz from a 2-Mt ore throughput in 2002 as a result of the expansion. However, underground expansion is expected to continue in 2003 with a focus on developing ore and infrastructure above the 215 level (2150 m or 7050 ft) below the surface to further increase production in 2003 and 2004. Overall in 2002, while ore grade, metallurgical recoveries, and processing and hoisting capacity have improved, there were operational problems including fewer gold-copper mining blocks for access at depth as expected due to a mechanical failure affecting the developent of high-grade areas. Development delays caused by a massive rock fall in one of the high-grade stoping areas in March 2003 also resulted in lower production early in the year. As well, cash operating costs averaged US$141/oz, 7% higher than in 2001 (US$132/oz). Total cash costs amounted to US$182/oz, a 17% increase from US$155/oz in 2001. As of December 31, 2002, ore reserves stood at 37.823 Mt grading 3.347 g/t gold, 69.776 g/t silver, 0.375% copper and 3.42% zinc. The current exploration focus is on deep exploration drilling in Zone 20 North, which is wide open below the 215 level with known thicker mineralization and a strong indication of better gold grades.

Troilus	Chibougamau	Que.	16 000	285	2002	O/P	Gold	Inmet Mining Corporation

Remarks: In 2002, the Troilus gold mine near Chibougamau, Quebec, substantially enhanced its operation through a series of improvements including an expansion of its mill capacity to 16 000 t/d from 10 000 t/d, better mining efficiency in the main pit, and improved grade controls at a capital cost of $8.3 million. The mine produced 165 000 oz of gold in 2002 at a cash cost of US$247/oz. Additional in-fill drilling was recently completed on the J-4 zone located 1000 m from the main 87 open pit. These developments have resulted in a revision to the mine reserves and life-of-mine plan. Revised proven and probable reserves at Troilus as at December 31, 2002, were 42.5 Mt grading 0.9 g/t gold (or 1.04 million oz) and 0.09% copper (32 000 t), doubling a previous estimate of gold and copper reserves of 55 000 oz of gold and 18 000 t of copper. The new pit designs are based on a gold price of US$325/oz and a copper price of US$0.90/lb with a mining dilution of 5%. The average life-of-mine cash cost of gold production is estimated at US$240/oz with a break-even cash cost at US$270/oz. The increased mine reserves effectively doubled the mine life at Troilus to eight years to 2010.

TABLE 2 (cont'd)

Mining Project/Remarks	Location	Province/ Territory	Capacity	Employment During Mine Life	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Company
			(t/d)					
Lac des Iles	Thunder Bay	Ont.	15 000	275	2000-2002	O/P	Palladium, platinum, gold, copper, nickel	North American Palladium Ltd.
Remarks: Reflecting a successful expansion of mine reserves in 1999, North American Palladium Ltd. launched a $220 million, three-year capital program in 2000 to expand production at its Lac des Iles mine located 985 km north of Thunder Bay, Ontario. A new concentrator, which was completed in June 2001, boosted the ore throughput capacity from 2400 t/d to 15 000 t/d. In 2002, the mine produced 220 000 oz of palladium, compared with 95 116 oz in 2000 before the expansion. Annual palladium production from the mine was expected to increase to 250 000 oz, or 5% of the world's annual palladium supply, by 2002. Total capital expenditures in 2002 were estimated at $70 million. A new, larger pebble crusher was installed in October 2001. This, together with modifications to the grinding and flotation circuits, the contracting out of fine-ore crushing, and the installation of a new liner in the semi-autogenous mill completed in 2002, has improved mill throughput and recoveries. However, in the long run, a secondary crusher, modifications to the grinding circuit, and possibly an expansion of the flotation circuit would be needed. The mine produces a single bulk concentrate containing palladium, platinum, gold, copper and nickel. The concentrate is trucked to Sudbury, Ontario, for smelting by Inco Limited and Falconbridge Limited, and is then shipped to these companies' respective European operations for refining. In 2002, exploration continued in the "Offset High Grade" zone, which is a faulted extension of the Main High Grade zone at depth discovered in 2001. The intercepts within this zone were exceptional with an average palladium grade of 5.2 g/t over a true thickness of 23 m. As of December 31, 2002, ore reserves were 93.5 Mt grading 1.53 g/t palladium (4.6 million oz), 0.17 g/t platinum, 0.12 g/t gold, 0.06% copper and 0.05% nickel. Measured and indicated resources totalled 65.9 Mt grading 1.58 g/t palladium (3.3 million oz), 0.17 g/t platinum, 0.11 g/t gold, 0.05% copper and 0.05% nickel. In addition, inferred resources totalled 73 Mt grading 1.57 g/t palladium, 0.15 g/t platinum, 0.10 g/t gold, 0.05% copper and 0.05% nickel. At full production, starting in the second half of 2003, annual output is expected to be 250 000 oz of palladium, 23 000 oz of platinum, 18 000 oz of gold, 6 million lb of copper and 2 million lb of nickel at a cash cost of US$200/oz of palladium. The mine currently employs 275 people, compared to 130 prior to the expansion. The Lac des Iles mine is Canada's only primary palladium mine.								
Musselwhite	Opapimiskan Lake	Ont.	4 000	266	2001-2002	O/P and U/G	Gold	Placer Dome Inc. and Kinross Gold Corporation
Remarks: The Musselwhite gold mine, near Opapimiskan Lake in northern Ontario, first began production on April 1, 1997. The mine produced 209 460 oz of gold in 2002. Between production start-up in April 1997 and December 31, 2002, the mine produced 1 453 200 oz of gold from more than 7 Mt of ore mined. An expansion to take the mine and mill to 4000 t/d from 3300 t/d began in 2001 and was completed in June 2002. Capital costs for the expansion were estimated at about $5 million. The installation of an underground jaw crusher and conveyors to bring ore to surface from the 460-m level, as well as improvements in the mill and tailings treatment reactor tank, helped boost the ore capacity. In 2003, production is forecast at 236 450 oz of gold from 1 436 000 t of ore throughput. As of December 31, 2002, proven and probable reserves stood at 8.11 Mt grading 5.4 g/t gold, containing 1.419 million oz. Measured and indicated resources were 3.108 Mt grading 7.1 g/t gold. In addition, there were 2.245 Mt of inferred resources grading 7.6 g/t gold. Based on current mineral reserves, Musselwhite has an expected mine life through to 2011. The mine plan includes seven ore deposits: T Antiform, OP, PQ, Esker, West Anticline, Intraformational and the West Zone. The mine employs 266 full-time employees and 101 First Nation contractors for support services.								
Red Lake	Balmertown	Ont.	550	(e) 175	2000-2002	U/G	Gold	Goldcorp Inc.
Remarks: Since the re-opening of the Red Lake mine in August 2000, both production and ore reserves at the mine have grown considerably. In 2001, gold production from the mine, mainly from the High Grade Zone, was a record 503 385 oz at a cash cost of US$59/oz, making Red Lake the largest gold-producing mine in Canada. This was followed by a further increase to 525 000 oz in 2002 at a cash cost of US$65/oz. For 2003, gold production from the Red Lake mine is forecast at over 500 000 oz at a cash cost of less than US$75/oz. Gold reserves also increased steadily since the mine's re-opening in 2000. As of December 31, 2002, proven and probable reserves in the High Grade Zone (HGZ) were 1.775 Mt grading 80.57 g/t (2.35 oz/st) gold, for a total of 4.594 million oz, a 21% increase in gold content over 2001. The HGZ represents the richest gold deposit in the world. In addition, proven and probable reserves in the sulphide zones totalled 1.368 Mt grading 12 g/t (0.35 oz/st) gold, or 533 000 oz. The mine also hosts a combined measured and indicated resource of 0.957 Mt grading 22.28 g/t (0.65 oz/st) gold and an inferred resource of 0.748 Mt grading 39.43 g/t (1.15 oz/st) gold. Currently, the Red Lake mine is in the midst of a US$12 million exploration program to expand reserves and resources, the largest ever undertaken at the mine. Although the mine completed a three-year expansion program in 2002 (with an estimated $4 million capital cost in 2002), it is poised for further expansion. In February 2003, owner Goldcorp Inc. announced a new US$85 million program to expand production capacity at the Red Lake mine over three years. A planned new shaft will increase the hoisting capacity by more than 200% to 4000 st/d, of which 2500 st/d could be ore.								
Base Metals								
Niobec	Chicoutimi	Que.	3 400	218	1998-2002	U/G	Niobium, ferroniobium	Cambior Inc. and Mazarin Inc.
Remarks: As part of the current $15.7 million expansion program at the Niobec niobium mine near Chicoutimi, Quebec, mill capacity has been increased to 3400 t/d from 2700 t/d with mine reserves increased by 26% during 2002. At year-end 2002, total proven and probable reserves stood at 23.8 Mt grading 0.65% Nb_2O_5. More than 90% of the reserves are located above level 1450 and can be mined using the current underground infrastructure, reducing the development expenditures for their extraction. The increase in reserves effectively extended the mine life to at least 18 years at the current mining rate. Further extension of mine life is possible as the deposit is open at depth. In 2002, capital expenditures amounted to about $2.4 million. Planned capital expenditures for 2003 are estimated at $3.8 million, mainly for underground infrastructure development and the construction of a new tailings pond. Niobec is the only producer of niobium in North America and is the third largest producer in the world. The Niobec mine produces a pyrochlore concentrate, which is transformed into ferroniobium grading 66% niobium using an aluminothermic converter. Ferroniobium is used as a micro-alloy additive to improve the mechanical properties and corrosion resistance of steel.								

Kidd Creek	Timmins	Ont.	12 500	603	2000-2004	U/G	Copper, zinc, silver	Falconbridge Limited

Remarks: The development of the $640 million Mine D deep mine project at the Kidd Mining Division in Timmins, Ontario, continued in 2002. The project, which began in late 2000, aims to extend the mine life at the Kidd Creek mine beyond 10 years by deepening the mine from a depth of 6800 ft to 10 000 ft, giving access to an additional 10.3 Mt of reserves and 14.1 Mt of resources. Production from Mine D is scheduled to begin in 2004 and is expected to ramp up to 750 000 t in 2005. Mine D development is being carried out in two stages. The Stage 1 portion of the mine, from 2100 m to about 2700 m, contains about 15.7 Mt of ore grading 2.82% copper, 5.74% zinc and 58 g/t silver. The Stage 2 portion, further down to 3100 m deep, contains 10.5 Mt grading 2.20% copper, 5.27% zinc and 97 g/t silver. As of December 31, 2002, total proven and probable reserves at the Kidd Creek mine stood at 23.7 Mt grading 2.11% copper, 6.30% zinc and 66.46 g/t silver. In addition, there were 100 000 t of indicated resources grading 2.96% copper, 6.79% zinc and 50 g/t silver, and 14.1 Mt of inferred resources grading 3.40% copper, 4.90% zinc and 91 g/t silver. In 2002, the overall cash operating costs of the Kidd Creek mine averaged US$0.62/lb of copper, net of by-product credits. Capital costs in 2002 were estimated at about $100 million.

Creighton	Sudbury	Ont.	(e) 3 500	525	2001-13 (Phase 1), 2005-19 (Phase 2)	U/G	Nickel, copper, cobalt, precious metals	Inco Limited

Remarks: A US$125 million, two-phase capital program to extend the mine life and to expand mine production at the Creighton nickel mine in Sudbury, Ontario, continued in 2002. Capital expenditures in 2002 were estimated at about $10 milllion. The Creighton Deep project, which was announced by Inco Limited in April 1998, aims to develop a 6-Mt high-grade, low-cost nickel-copper deposit at depth at the Creighton mine over the next two decades. Phase 1 of the project, from 2001 to 2013, which involves mine development between the 7400-ft and 7660-ft levels, will develop proven reserves of 2.8 Mt grading 3.45% nickel and 2.97% copper located between the two levels. Production from this ore has already begun. In Phase 2, development will extend to the 8180-ft level between 2005 and 2019, during which some 3.1 Mt of probable reserves grading 3.62% nickel and 3.25% copper will be developed and mined. In contrast, the current average grades of the Ontario Division mines are 1.3% nickel and 1.2% copper. When Creighton Deep is fully operational (originally planned for 2002), annual production is expected to be 10 900 t of nickel, 9500 t of copper and 28 000 oz of platinum group metals. The Creighton orebody was discovered in 1856. The mine, which began production in 1901, celebrated a century of continuous production in 2001. Creighton is Inco's oldest operating mine.

Garson	Sudbury	Ont.	1 900	(e) 150	2002	U/G	Nickel, copper, cobalt, precious metals	Inco Limited

Remarks: In 2002, Inco decided to deepen the Garson mine in Sudbury to access ore located between 1360 m and 1550 m below surface, thereby extending the mine life from one year to nine years. Production is also expected to increase from some 1900 t/d to about 2100 t/d. Capital costs for this development are estimated at US$43 million ($60 million). The Garson mine first began production in 1907. Production was suspended in 1986 due to ground stability problems. The mine re-opened in late 1993. Ore is processed at the Clarabelle mill.

McCreedy East	Sudbury	Ont.	2 700	180	2000-2004	U/G	Nickel, copper, cobalt, precious metals	Inco Limited

Remarks: The discovery of a high-grade nickel deposit near the McCreedy East mine in Sudbury, Ontario, prompted Inco Limited to announce a $48 million (US$33 million) capital program to develop the orebody in June 2000. It will involve the development of the Main and adjacent West orebodies containing 8 Mt grading 1.88% nickel, 0.84% copper and 0.91 g/t platinum group metals. Mine production is expected to increase to 4350 t/d from the current 2700 t/d when full production is reached in late 2004. At this rate, metal production will be 22 million kg (48 million lb) of nickel and 42 million kg (92 million lb) of copper annually, up from the current 13 million kg (29 million lb) of nickel and 37 million kg (82 million lb) of copper. Capital costs for the 2002 expansion were estimated at about $12 million. The expansion of the McCreedy East mine will provide Inco's Ontario Division with another source of low-cost production for at least another 15 years. Further mine-life extensions are likely as the mine hosts other mineral zones with excellent potential. The McCreedy East mine is one of Inco's most productive mines with ore handling and materials transportation accessible by existing infrastructure at the company's nearby Coleman mine. It has been designated by Inco as one of four key mines in its Ontario Division. The other three, Creighton, Copper Cliff North and Copper Cliff South, are all in the Sudbury area. All four are the company's lowest-cost mines in Ontario.

Birchtree	Thompson	Man.	3 175	150	2001-02	U/G	Nickel, copper, cobalt, precious metals	Inco Limited

Remarks: A US$48 million ($70.4 million), two-year capital program announced by Inco Limited in February 2000 to extend the life of the Birchtree nickel mine near Thompson, Manitoba, to 2016 was completed in 2002. The project was expected to deepen the mine and increase production to 3175 t/d from 1635 t/d while reducing costs by approximately 25%. As a result, ore reserves also increased to 13.6 Mt grading 1.79% nickel. The mine is expected to reach full production in 2004. A joint effort by a company/union co-design team made the deepening financially viable by redesigning the mine development plan to further lower costs and accelerate cash flow. The Birchtree mine operated from 1966 to 1977, returning to production most recently in 1989. Inco is also studying the deepening of its Thompson 1-D orebody and is re-surveying the entire Thompson Nickel Belt. Both activities are part of Inco's overall exploration strategy to focus on discovering new mineralization near current mines and previously known deposits. This strategy has proven to be successful in recent years.

Other Commodities

Carol Lake	Labrador City	N.L.	(e) 49 500 (conc. and pellet)	. .	1998-2003	O/P	Iron	Iron Ore Company of Canada

Remarks: The six-year, $1.1 billion comprehensive capital investment program that started in October 1998 continued in 2002, albeit at a slower rate. About $650 million, or 60%, of the investment will be spent on upgrading and expanding the company's Carol Lake mine, concentrator and pellet plant near Labrador City. Another $361.5 million will be spent on reactivating the pellet plant at Sept-Îles, Quebec, which was mothballed in 1982. However, completion of the Sept-Îles iron ore pellet plant, originally scheduled for 2002, was postponed due to poor iron ore market conditions in the first half of 2001. Stabilization of iron ore prices in 2002 followed by further improvement in 2003 may offer hope for work resumption at the Sept-Îles plant and for putting the overall investment program on track.

TABLE 2 (cont'd)

Mining Project/Remarks	Location	Province/ Territory	Capacity	Employment During Mine Life	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Company
			(t/d)					
Ekati	Lac de Gras	N.W.T.	9 000	650	2001-08	O/P and U/G	Diamonds	BHP Billiton Diamonds Inc., Charles E. Fipke and Stewart Blusson
Remarks: The Ekati diamond mine, located in the Lac de Gras area of the Northwest Territories, began production on October 14,1998. The mine was developed at a capital cost of US$700 million. Although it is generally referred to as the Ekati mine, it is a mining complex that initially consisted of five diamond-bearing kimberlite pipes, namely, Panda, Koala, Misery, Sable and Fox. The five pipes were approved by the federal government to be developed as five mines for production between 1998 and 2008, sharing one common mill at the Panda site. Mine reserves and resources initially totalled some 133 Mt, with 78 Mt scheduled to be mined over a 17-year initial mine life. Given the discovery of additional pipes, several of them higher-grade, the mine plan was revised to take into consideration the new pipes that are closer to the central mill site, such as the Koala North, Lynx, Jay, Beartooth and Pigeon pipes that were discovered between 1993 and 1999. As a result of the mine plan revision, priority was given to the development of the Misery pipe as the Ekati mine's second open-pit operation, followed by the Koala North underground operation. With the diamond production from the Misery pipe that began in December 2001 and from the Koala North underground mine that started in August 2002, as well as other pipes in the planned sequence, the production capacity at the Ekati mine is inching towards the planned 18 000 t/d from the current 9000 t/d. The capital costs of developing the new production capabilities in 2002 were estimated at $50 million.								
PRODUCTION SUSPENSIONS								
Precious Metals								
Kiena	Val-d'Or	Que.	2 000	(e) 75	September	U/G	Gold	McWatters Mining Inc.
Remarks: Production at the Kiena gold mine near Val-d'Or, Quebec, was suspended in late September 2002 due to high costs. However, recent successes from both surface and underground exploration have been encouraging. From a Phase 1 underground exploration program completed in December 2002, McWatters Mining Inc. has delineated a measured and indicated resource of 2.9 Mt grading 4.26 g/t gold (396 000 oz) contained in the Hanging Wall zone. The second phase has now established several zones in the Hanging Wall zone, including the P-zone, which was identified in Phase 1 and has been traced for over 1.2 km along strike.								
Other Minerals/Metals								
Hurley	Trinity Bay	N.L.	(e) 70	(e) 48	August 16	O/P	Slate	Hurley Slate Works Inc.
Remarks: Production at the Hurley slate mine was suspended in August 2002 due to a licensing dispute with the Newfoundland and Labrador government. The mine was brought on stream in 2000 as a significant dimension stone producer in the Trinity Bay area and is one of the largest industrial mineral producers in the province. The operation is seasonal. Owner Hurley Slate Works Inc. expects to obtain the licensing permit and to restart production in 2003.								
McClean Lake	McClean Lake	Sask.	300	175	September 23	O/P	Uranium	COGEMA Resources Inc., Denison Energy Inc. and OURD (Canada) Co., Ltd.
Remarks: Uranium production at the McClean mine in northern Saskatchewan was suspended due to a September 23, 2002, Federal Court ruling that quashed the operating licence for the mine's ore processing plant. The ruling was the result of a complaint filed by the Inter-Church Uranium Committee Educational Co-Operative against the Canadian Nuclear Safety Commission (CNSC). The licence was issued to COGEMA Resources in June 1999, the year production began at McClean Lake, and renewed for a four-year term ending on August 31, 2002, with an increasing uranium production limit of 3077 tU/y. Mining at McClean Lake was completed in 2001 when the Sue C open pit - the last pit of the mine - was mined out and mine-site reclamation has already begun. However, ore stockpiles, including those from the previously mined-out JEB deposit, will provide sufficient feed to the mill for uranium concentrate production for several years. The McClean Lake mill will process ore from the Cigar Lake, currently under development, and Midwest mines when they begin production. The facilities received ISO 14001 certification in 2001 and are recognized as a model of environmental and safety management. The McClean Lake uranium deposit was discovered in 1979 and has approximately 20 000 t of reserves at an ore grade of 2.8% U.								
MINE CLOSURES								
Precious Metals								
Bousquet (Bousquet No. 2)	Cadillac	Que.	2 450	(e) 190	December	U/G	Gold	Barrick Gold Corporation
Remarks: Production at the Bousquet gold mine near Cadilllac, Quebec, ceased in December 2002 due to the depletion of economically mineable ore. in production since 1989, the Bousquet No. 2 mine was one of several Abitibi properties acquired when Barrick Gold Corporation purchased Lac Minerals Ltd. in 1994. At that time, it was known as the Bousquet Complex with the Bousquet No. 1 mine in production. Ore from the Complex was trucked to Barrick's 2700-t/d East-Malartic mill for processing.								

Base Metals

Crean Hill	Sudbury	Ont.	1 900	(e) 150	June	U/G	Nickel, copper, cobalt, PGM	Inco Limited

Remarks: In June 2002, Inco Limited closed its Crean Hill nickel-copper mine in Sudbury as economic ore was depleted. The mine first began production in 1905.

Ruttan	Leaf Rapids	Man.	5 800	(e) 360	June	U/G	Copper, zinc	Hudson Bay Mining and Smelting Co., Limited

Remarks: The Ruttan copper-zinc mine near Leaf Rapids, Manitoba, closed in June 2002 due to depletion of mineable reserves. Mine production first began in 1973. Decommissioning and rehabilitation are being carried out by owner and operator Hudson Bay Mining and Smelting Co., Limited.

Nanisivik	Nanisivik	Nun.	2 300	200	September	U/G	Zinc, silver	Breakwater Resources Ltd.

Remarks: The Nanisivik zinc-silver mine on northern Baffin Island, Nunavut, was permanently closed in September 2002. The mine first began production in October 1976. Breakwater Resources Ltd. acquired the mine in July 1996 from AEC West Ltd. (formerly Conwest Exploration Company Limited) and operated the mine through CanZinco Ltd., a wholly owned subsidiary. The closure was the result of a new mine plan that eliminated mining of the lower-grade portion of the orebody, due largely to lingering low zinc and silver prices.

Polaris	Little Cornwallis Island	Nun.	2 850	220	September	U/G	Zinc, lead	Cominco Mining Partnership and Teck Cominco Limited

Remarks: The Polaris zinc-lead mine on Little Cornwallis Island, Nunavut, closed in September 2002 after 21 years of operation due to ore depletion. The mine was the world's most northerly base-metal mine. A two-year, $53 million mine decommissioning and reclamation program, under way since October 2002, is expected to be completed in the third quarter of 2004.

Other Minerals/Metals

Cluff Lake	Cluff Lake	Sask.	800	(e) 200	December	U/G	Uranium	COGEMA Resources Inc.

Remarks: Uranium production from the Cluff Lake mine ceased at the end of 2002 due to ore depletion. The mine first began production in 1980 and had been producing 1000 to 2000 t of uranium concentrates each year. Cumulative production to the end of 2000 exceeded 20 000 t of uranium concentrates (U_3O_8). Mine-site reclamation is in progress in 2003.

Source: Natural Resources Canada, based on published reports and communications with companies and provinces/territories.
. . Not available; (e) Estimated; O/P Open pit; U/G Underground.

TABLE 3. NEW PRODUCTION FROM MINE OPENINGS IN CANADA IN 2002

Mining Project	Main Commodities	Estimated Annual Production							
		Gold		Silver		Copper	Nickel	Zinc	Other Minerals/Metals
		(g)	(oz)	(g)	(oz)	(t)	(t)	(t)	
NEW OPERATIONS									
Precious Metals									
Mishi open-pit	Gold	217 000	7 000	–	–	–	–	–	–
RE-OPENINGS									
Precious Metals									
Beaufor	Gold	1 736 000	56 000	–	–	–	–	–	–
Sigma Lamaque	Gold	3 420 000	110 000	–	–	–	–	–	–
Joe Mann	Gold	2 294 000	74 000	–	–	725	–	–	–
Macassa	Gold	1 866 000	60 000	–	–	–	–	–	–
Base Metals									
Gertrude	Nickel, copper	–	–	–	–	5 000	5 000	–	–
Myra Falls	Zinc, copper, gold, silver	806 000	26 000	23 250 000	750 000	10 000	–	60 000	–
Other Minerals/Metals									
Eagle Point	Uranium	–	–	–	–	–	–	–	2 700 t U_3O_8 (6 million lb U_3O_8)
CanTung	Tungsten	–	–	–	–	–	–	–	3 000 t tungsten concentrates
Planned total		10 339 000	333 000	23 250 000	750 000	15 725	5 000	60 000	2 700 t U_3O_8 (6 million lb U_3O_8) 3 000 t tungsten

Source: Natural Resources Canada, based on company reports and communications with companies.

– Nil.

Note: 2002 diamond production from the new Misery and Koala North underground kimberlite pipes at the Ekati mine in the Northwest Territories is not included in the above table.

TABLE 4. NEW ORE RESERVES FROM MINE OPENINGS IN CANADA IN 2002

Mining Project	Main Commodities	Proven-Probable Ore Reserves (e)		In-Situ Metal Reserves								
		Tonnage	Grade	Gold	Gold	Silver	Silver	Copper	Nickel	Zinc	Lead	Other Minerals/Metals
		(t)		(g)	(oz)	(g)	(oz)	(t)	(t)	(t)	(t)	(t)
NEW OPERATIONS												
Precious Metals												
Mishi open pit	Gold	210 000	3.1 g/t gold	651 000	21 000	–	–	–	–	–	–	–
RE-OPENINGS												
Precious Metals												
Beaufor	Gold	1 012 400	7.54 g/t gold	7 633 500	245 400	–	–	–	–	–	–	–
Sigma Lamaque	Gold	14 965 000	0.5 g/t gold	39 058 600	1 258 000	–	–	–	–	–	–	–
Joe Mann	Gold	1 228 300	10.41 g/t gold	12 786 600	411 100	–	–	3 250	–	–	–	–
Macassa	Gold	725 750	15.42 g/t gold	11 191 000	359 800	–	–	–	–	–	–	–
Base Metals												
Gertrude	Nickel, copper	1 200 000	1% nickel 1% copper	–	–	–	–	10 000	10 000	–	–	–
Myra Falls	Zinc, copper, lead, gold	8 267 000	6.7% zinc 1.25% copper 0.57% lead 1.22 g/t gold 40.51 g/t silver	10 085 700	324 200	334 896 000	10 767 000	103 300	–	5 538 900	47 100	–
Other Minerals/Metals												
Eagle Point	Uranium	1 570 630	0.76% U_3O_8	–	–	–	–	–	–	–	–	9 000 tU
CanTung	Tungsten	560 000	1.82% WO_3	–	–	–	–	–	–	–	–	10 000 t WO_3
Total				81 406 400	2 619 500	334 896 000	10 767 000	116 550	10 000	5 538 900	47 100	9 000 tU 10 000 t WO_3

Source: Natural Resources Canada, based on company reports and communications with companies.
– Nil; (e) Estimated.
Note: Diamond ore reserves of the Misery and Koala North kimberlite pipes (brought into production in 2001 and 2002, respectively) at the Ekati mine in the Northwest Territories are not included in the above table.

International Scene

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Natural Resources Canada (NRCan) has a legislated mandate to promote the sustainable development of minerals and metals internationally. During 2002, international activities, programs, trade and investment missions, and partnerships were maintained, or newly created, and provided the framework by which the Minerals and Metals Sector was able to demonstrate the innovation, technologies and leadership of Canada's mining, minerals and metals sector on a global scale.

INTERNATIONAL BUSINESS DEVELOPMENT AND TRADE MISSIONS

EXPOMIN 2002, Santiago, Chile

Held in May 2002, EXPOMIN 2002 provided an excellent opportunity to promote Canada as a world leader in the minerals and metals sector and to develop partnerships that will continue to have a significant contribution to strengthening the mining industry throughout the world. A total of 105 Canadian companies were represented with participation in 60 booths. EXPOMIN is a biennial international trade show that is rated, in terms of participation, as the world's second largest mining trade show after MINEXPO in Las Vegas, Nevada. EXPOMIN covers a wide spectrum of products and services for the mining industry and brings together more than 2300 exhibitors from 36 countries, drawing about 43 000 visitors.

At EXPOMIN 2002, NRCan developed collaborative partnerships with other government departments and organizations in order to showcase Canada's mining expertise and cutting-edge technology, as well as Canada's commitment to the sustainable development of its natural resources. The partnership consisted of the Canadian Embassy in Chile, the Department of Foreign Affairs and International Trade (DFAIT), the Canadian Association of Mining Equipment and Services for Export (CAMESE), Export Development Canada, the Canadian Commercial Corporation, and the provincial governments of Ontario and Quebec. NRCan received financial assistance from DFAIT, under the Team Canada Inc.'s Brand Canada Program, to promote the image and visibility of Canada at EXPOMIN 2002.

As part of the cultural activities of the Brand Canada Program, an Inuit stone carver, Henry Kudluk, showcased stone-carving techniques for visitors to the Canadian Pavilion, and catering services were provided by a Cree chef from northern Saskatchewan, Arnold Olson. Mr. Olson has won numerous culinary awards, including the Gold Aboriginal Team Award at the World Culinary Olympics in Germany. The participation of Mr. Kudluk and Chef Olson at this trade fair provided an opportunity to enhance and build partnerships with Canadian Aboriginal businesses and to continue collaborating in joint business development initiatives.

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Naturallia 2002 - International Business Forum, Rouyn-Noranda, Quebec

As part of a continuing effort to develop new ways to help Canadian small and medium-sized enterprises (SMEs) access new markets, the Minerals and Metals Sector of NRCan joined other federal, provincial, municipal and industry partners in supporting Naturallia 2002. Held October 29-31, 2002, this was the first international natural resources business development forum organized in the northern regions of Quebec and Ontario. Specializing in the mining and forestry sectors, this business development forum is aimed at building international business partnerships and alliances. Government sponsors at the federal level included NRCan, FedNor (Federal Economic Development Initiative for Northern Ontario), and Canada Economic Development for Quebec Regions. The governments of Quebec and Ontario were also involved. The main corporate sponsors were 48^{e} Nord International, Noranda Inc., and Tembec Inc.

The business development program comprised three sessions of four 30-minute match-making meetings. In total, there were approximately 500 match-making meetings arranged for participants. This format offered an opportunity to briefly discuss potential business prospects among the 135 participants from Argentina, Australia, Brazil, Canada, Chile, Peru, South Africa, the United Kingdom, and the United States. Many of the participants visited CANMET's Mining and Mineral Sciences Laboratories booth in the Village des Experts, as well as the Government of Canada booth. In addition to the match-making sessions, the program also included industrial visits in both Quebec and Ontario, social networking events, and an on-site exhibition to exchange information and expert knowledge.

The next NATURALLIA Business Development Forum is planned for northern Ontario in 2004.

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ELECTRA MINING 2002, Johannesburg, South Africa

Held every two years, ELECTRA MINING is the premier mining event in Africa and the only trade show that offers Canadian suppliers of equipment and services an opening to this large, regional mining market. Since its inception 30 years ago, ELECTRA MINING has grown to become the largest specialized industrial exhibition in Africa and ranks among the three largest mining shows in the world.

There were about 35 000 visitors and over 600 exhibitors participating in ELECTRA MINING 2002 from Canada, China, Germany, India, Poland, Russia, South Africa, the United Kingdom, and the United States. Approximately 60 Canadian companies were represented in 14 booths (indirect participation was through posters and the distribution of literature), including 23 companies attending on-site. As a result of the promotional efforts of NRCan and CAMESE, under the Brand Canada Program, Canadian company direct participation increased from 4 companies in 2000 to 23 companies in 2002. The companies came from British Columbia, Ontario and Quebec.

The program included: industrial visits to South African manufacturers of equipment, a diamond-cutting plant, and the South Deep mine owned by Placer Dome Inc.; seminars on current trends and how to penetrate the African market in areas such as equipment selection, blasting techniques, mine planning and grade control, rock mechanics, outsourcing and information technology, operational issues, environmental issues, and health and safety; a regional debrief from the Trade Office of the Canadian High Commission; and a networking reception.

Canada's participation in ELECTRA MINING 2002 provided many opportunities to showcase our innovative approaches and expertise in mining and technology and to establish and develop contacts with key African decision-makers.

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Team Canada Inc. Mission to Russia

The Prime Minister of Canada, the Right Honourable Jean Chrétien, led a Team Canada mission to Russia and Germany in February 2002. He was accompanied by eight provincial premiers, three territorial leaders and more than 200 representatives from Canadian companies. Team Canada's main objectives in Russia were to alert Canadian businesses to the promising re-emergence of the Russian marketplace and to help them, as individual companies, make informed and timely decisions about initiating new, or pursuing existing, opportunities under the aegis of Team Canada.

Team Canada's business program in Russia comprised 285 delegates representing 219 private and public sector organizations; 11 of these were from the mining sector and 21 were from the oil and gas sector. The actual business deals concluded during Team Canada's visit to Moscow comprised 77 agreements valued at $337 million; there were 25 contracts amounting to $148 million, mainly in the areas of information and communication technologies, construction and building materials, oil and gas equipment, educational services, and agrifood and agriculture. There were also 52 memoranda of understanding and letters of intent signed, totalling an estimated $189 million, mainly in construction and education.

The plenary session, with its macro perspective, was followed by seven concurrent seminars designed to provide Canadian delegates with more detailed information on the challenges and opportunities awaiting Canadian business in Russia. Six of the seminars had a sectoral focus, including agrifood and agriculture, educational services, information and communication technologies, oil and gas, residential construction and building materials, and mining. The seventh seminar addressed generic issues under the heading "Doing Business in Russia."

The mining seminar was titled "Russia's Minerals and Metals Sector - Business Opportunities for Canadian Companies," and was chaired by a representative of the

Minerals and Metals Sector of NRCan. Participants in the seminar included representatives from Canadian and Russian mining companies, the Russian State Duma, and the Canadian and Russian governments. The Minerals and Metals Sector has been playing a leading role in the Mining Working Group of the Canada-Russia Intergovernmental Economic Commission since it was created in 1998. The working group was successful in raising the concerns of Canadian mining companies with Russian governments, in holding a number of investment seminars, and in facilitating the negotiation of bilateral agreements regarding investment and geoscience collaboration.

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Trade Mission to South Africa

In February 2002, the Minister of Natural Resources Canada, Herb Dhaliwal, led a trade mission to South Africa. Some members of the mission also visited a capacity-building project in Zambia funded by the Canadian International Development Agency (CIDA) for which CANMET is the executing agency. The Zambia project addresses governance issues in relation to environmental management and mining activities. The same members of the delegation also accompanied Placer Dome officials on a tour of a CARE project that helps retrenched workers reintegrate into the labour force.

The objectives of the mission included: coordinating a full-day training session for African-based Canadian Trade Commissioners on Canada's minerals and metals sector; attending the Indaba Conference, Investing in African Mining to gather regional market intelligence, promote the use of Canadian mining-related equipment and service providers, and the adoption/maintenance of fair and transparent mineral regimes for Canadian companies operating in the region; promoting market access and sustainable development principles in the region; and exploring options to promote the development of the Africa Mining Partnership as part of the New Partnership for African Development. With respect to the last objective, NRCan held productive meetings with representatives from the governments of Botswana, Cameroon, Ivory Coast, Ethiopia, Gabon, Ghana, Malawi, South Africa, Tanzania, and Zambia.

Meetings between NRCan officials and Canadian mining companies operating in South Africa focused on the implications of South Africa's proposed Mineral Development Law for Canadian companies. Concerns were raised by Canadian companies with respect to the extent of ministerial discretion in the proposed legislation. Canadian companies will be asking The Mining Association of Canada and the Prospectors & Developers Association of Canada to make formal submissions to the South African government on their behalf.

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Trade Mission to India

In November 2002, the Minister of Natural Resources Canada, Herb Dhaliwal, led a successful business development mission to India. The Minister was accompanied by representatives from 45 companies within the natural resources sector and allied industries. In addition to NRCan, there was official representation from Export Development Canada, the Canadian Commercial Corporation, Industry Canada, and Alberta Economic Development.

As part of his efforts to increase Canada's trade with and investment in India, Minister Dhaliwal met with his counterpart at the Ministry of Coal and Mines and actively supported the many networking events in each of the cities visited. As part of this mission, NRCan organized seminars in New Delhi, Hyderabad and Calcutta to promote Canadian suppliers of equipment and services in mining, geoscience and geomatics.

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INTERNATIONAL PARTNERSHIPS

World Summit on Sustainable Development (WSSD)

The WSSD, held in Johannesburg, South Africa, between August 26 and September 4, 2002, marked the 10th anniversary of the United Nations Conference on Environment and Development (UNCED). The interest shown in the preparatory regional intergovernmental meetings on the management of natural resources, including mineral resources, allowed Canada and other countries to succeed in bringing the topic of mining, minerals and metals into the world summit work program.

Canada chaired an informal negotiating group on mining, minerals and metals that succeeded in putting together a text that was accepted as paragraph 46 of the Summit's Plan of Implementation, which recognizes the positive economic and social contributions of mining in the context of sustainable development.

Paragraph 46 served as a backdrop for Canada and South Africa to announce at the Summit the creation of a partnership called The Global Dialogue of Governments on Mining/Metals and Sustainable Development. The partnership was formally announced in the course of the Summit at a press conference hosted by Canada. It is recognized as a Type 2 Partnership, i.e., it is formally recognized by the United Nations as supportive of the Summit Plan of Implementation.

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The Global Dialogue of Governments on Mining/Metals and Sustainable Development

Having raised the issue of mining and the challenges it faces in the global context at the World Summit on Sustainable Development, Canada recognized the need for a global forum in which interested governments could meet on an ongoing basis to address mining and metal issues from a government and integrated perspective in the context of sustainable development. While a number of regional and sector-specific fora exist, there is currently no active global forum that brings together governments to address these important policy issues. Together with South Africa, Canada proposed the creation of a global mechanism tied to the outcomes of the World Summit, "The Global Dialogue of Governments on Mining/Metals and Sustainable Development."

The Global Dialogue is being designed to bring together high-level officials with a responsibility for mining and metals policy in a forum where the member governments can exchange information and discuss issues, policies and regulatory approaches in the context of the contribution that the non-energy minerals and metals sector makes to sustainable development.

Reference to sustainable development will allow the forum to address the widest possible range of issues. The forum will not have any authority to develop and implement international rules, standards or conventions; however, it is expected that the forum could make recommendations or suggestions to intergovernmental bodies, individual governments or other stakeholders associated with the minerals and metals sector. As such, the national sovereignty of the member governments will be respected.

By the end of 2002 , some 35 countries from around the world with an interest in mining and metals had signaled their interest in starting the process to establish a Global Dialogue that will create an international government-led forum focusing on minerals and metals issues. Work continues to encourage countries to participate in the process of formulating the program of work, terms of reference, rules of procedure, and other aspects necessary for the operation of the forum. A preparatory meeting is being planned for the fall of 2003 with the inaugural meeting scheduled in early 2004.

The Global Dialogue represents a unique opportunity for governments and their delegations to make an important contribution to policy discussions aimed at improving the minerals and metals sector's contribution to sustainable development and enhancing its reputation worldwide. The potential benefits of the forum are clear, but their realization depends upon the active support of all with an interest in the sector. Additional information on the Global Dialogue is available on the Internet at www.globaldialogue.info.

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World Mines Ministries Forum 2002

The second World Mines Ministries Forum (WMMF 2002) took place in Toronto, March 13-15, 2002, immediately following the annual convention and trade show of the Prospectors & Developers Association of Canada (PDAC). WMMF 2002 was co-chaired by the Government of Ontario and the World Bank and was attended by more than 350 representatives from governments, industry, non-governmental organizations, Aboriginal groups, and international organizations.

NRCan officials played a prominent role at WMMF 2002, including organizing two of the six workshops (Sustainable Development: the Road to Johannesburg Summit 2002, and The Role of Geoscience in Attracting Investment) and acting as a facilitator in the workshop on Creating a Positive Investment Climate. The other themes addressed at WMMF 2002 were Governance Issues in the Mining Sector, Mining and People, and Dealing with Voluntary Codes of Conduct.

Participants in the geoscience workshop concluded that geoscience knowledge does indeed attract investment and that this knowledge should be promoted to exploration companies rather than to investors. There was unanimous agreement that resource development can go a long way to alleviate poverty in developing countries and that the poorest countries should be aided in the establishment of geoscience knowledge bases to help attract investment. Three of the panel members volunteered to assist in making this happen.

The Road to Johannesburg workshop included regional perspectives on mining and sustainable development from

South Africa, Latin America and the Philippines. Discussion focussed on evolving models for corporate responsibility, links between mining and poverty alleviation, links between mining and sustainable development, using mining as a platform for economic development, national governments and governance issues, capacity building, abandoned mines, and artisanal and small-scale mining.

The WMMF 2002 was also the occasion for the launching of the International Cyanide Management Code for the Gold Mining Industry. The code was developed through a multi-stakeholder process under the auspices of the United Nations Environment Programme (UNEP) and the former International Council on Metals and the Environment (ICME), now the International Council on Metals and Mining (ICMM).

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REGIONAL PARTNERSHIPS

The economies of APEC (Asia-Pacific Economic Cooperation) include not only major producers of minerals and metals, but also major consumers of metals and mineral products. Many economies, as a result, have a direct interest in the long-term viability of the minerals and metals sector. GEMEED, which is part of the APEC Energy Working Group (EWG), was formed in 1995. It remains the only forum for governments to discuss minerals and metals issues in the APEC region. Its objectives are:

- to work to enhance the contribution of mineral and energy resources to sustainable development, through environmentally and socially acceptable practices in exploration and development; and
- to identify, develop and promote synergies in the area of mineral and energy exploration and development with other national, regional and multilateral organizations.

APEC-Expert Group on Mineral and Energy Exploration and Development (GEMEED)

In April 2002, APEC-GEMEED supported an international workshop on life-cycle assessment (LCA) and metals. The workshop, which took place in Montréal, Quebec, was organized by NRCan, the United Nations Environment Programme (UNEP)/Society of Environmental Toxicology and Chemistry (SETAC), and the International Council on Metals and Mining (ICMM).

The workshop was successful in building bridges between the LCA community and interested scientists by considering environmental issues related to metals and identifying areas for future research. The workshop papers and conclusions will be available in 2004 from SETAC. Abstracts and presentations are available on the Internet at www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/enviro/lifecycle/default.htm.

In May 2002, the United States hosted an Environmental Cooperation Workshop on indigenous peoples and mining. The workshop covered a number of topics related to exploration, mining and mine closure, including:

- the involvement of native peoples in exploration and mining, with emphasis on the Northern Alaska Native Association (NANA) and Teck Cominco Limited's Red Dog mine in Alaska, as well as the Navajo and Hopi tribes and Peabody's Black Mesa mine in Arizona;
- international practices for community involvement and their relevance to mining projects; and
- community activities by mining companies such as Placer Dome/NovaGold Resources Inc. in Alaska and Minera Escondida Limitada in Chile.

In October 2002, China hosted APEC-GEMEED's 7th Plenary Meeting in Chongqing. The principal activities and achievements of APEC-GEMEED were:

- completion of a Chilean-led project on a Survey of Factors Influencing Demand for Metals and Minerals (principally copper, zinc, lead, nickel and iron);
- an agreement by members to hold a meeting of APEC Mines Ministers in Chile during 2004; and
- forging closer ties with international financial organizations, such as The World Bank Group.

China Mining 2002, held in conjunction with the APEC-GEMEED meeting, offered an excellent opportunity to understand first-hand the difficulties faced by foreign mining companies operating in China and to hear how China is trying to address these issues by reforming its investment climate for mining. NRCan officials gave presentations at China Mining 2002 on Public Geoscience as a Foundation for Resource Exploration: the Canadian Experience (by the Earth Science Sector) and Sustainable Development and Minerals and Metals: Governments and International Agendas (by the Minerals and Metals Sector).

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Annual Mines Ministries of the Americas Conference (CAMMA)

As an advisor to CAMMA's Executive Secretariat, NRCan's Minerals and Metals Sector was instrumental in obtaining accreditation for CAMMA as an intergovernmental organization with observer status at the 2002 World Summit on Sustainable Development in Johannesburg, South Africa. The international delegation consisted of a representative of CAMMA's Executive Secretariat, Victor Silva (Secretary of State of Industry and Commerce, Dominican Republic); the two international advisors to the Executive Secretariat, Roberto Sarudiansky (Ministry of Industry, Commerce and Mining, Argentina) and Kim Stirling (Minerals and Metals Sector, Natural Resources Canada); and Dr. Laura María Barreto (Centro de Tecnologia Mineral [CETEM], Brazil).

On behalf of CAMMA's 23 member governments, the Executive Secretariat delivered a statement during the plenary session. It emphasized the recognition of Heads of Government and State from the Americas and Caribbean for the economic and social contribution of mining, enunciated in the 3rd Quebec Summit of the Americas Action Plan. The statement also reaffirmed CAMMA's commitment to support and promote the implementation of policies that take into account environmental, social and economic considerations in government decision-making supported by science-based knowledge and to foster the development, promotion and safe use of minerals and metals.

CAMMA delegates at the World Summit also met with representatives from the Council for Mineral Technology (Mintek), the South African Department of Minerals and Energy, the South African Mining Chamber, and MEPC (a minerals and energy policy and research organization) in an effort to identify areas of common interest and possible future collaboration. The development of inter-continental relationships between members of CAMMA and member governments of the newly formed Africa Mining Partnership is reflective of CAMMA's commitment to discuss and exchange information about sustainable development policy initiatives within other mining policy fora, thereby contributing to sustainable development policy at a global level.

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BILATERAL PARTNERSHIPS

Korea Resources Corporation (KORES) Opens an Office in Toronto

Since the early 1990s, NRCan's Minerals and Metals Sector, in conjunction with the Canadian Embassy in Seoul, has actively encouraged KORES to open an office in Canada. KORES is a state-owned company with a mandate that includes supporting overseas mineral resource development. The official opening of the office occurred on March 12, 2002, the second day of the annual PDAC convention. Key mining executives and senior government officials attended the event, which featured both Mr. Chun Taek Park, President of KORES, and Mr. Benoît Serré, Parliamentary Secretary, Natural Resources Canada. The KORES Toronto office is the organization's third regional office; the other two offices are located in Beijing, China, and Sydney, Australia. In support of the KORES Toronto opening, the Minerals and Metals Sector coordinated an extensive orientation program in Toronto, Ottawa, Timmins, Sudbury and Vancouver for KORES's new Chief Executive Officer.

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Saudi Arabia-Canada Joint Economic Commission (JEC) Meeting

On June 13 and 14, 2002, committee meetings took place in Ottawa on Saudi Arabian mineral development and the role of Canadian companies.

Early indications are that a new Saudi mining code will be in force at the end of 2002, followed by the attendance of Saudi teams at such events as the PDAC convention in March 2003 in order to address investors and Canadian mining companies. In this context, the joint future activities of the Canadian and Saudi partners under the JEC will involve a seminar in Toronto with participation by Canadian and Saudi governments and companies involved in exploration, mining, and equipment and services. The purpose of the seminar would be to discuss future plans and activities that could lead to reciprocal increased trade and investment between Canada and Saudi Arabia. Another action plan will likely be the Saudi purchase of Canadian expertise in a number of areas, including environmental protection, geomatics and remote sensing.

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PARTNERSHIPS IN SCIENCE AND TECHNOLOGY

Global Mining Research Alliance

In June 2002 the government-funded mining research laboratories of Canada, Australia, South Africa and the United States established the Global Mining Research Alliance (GMRA). The partners in the GMRA are:

- **CANMET Mining and Mineral Sciences Laboratories**: CANMET-MMSL has almost 100 years' experience in working to support the Canadian and global mining and mineral processing industries. It is especially recognized for its expertise in technologies related to mine engineering, advanced mineralogy, and mine-related environmental sciences. CANMET-MMSL also brings to the table the expertise of the Geological Survey of Canada and the Mineral and Metal Policy Branch of NRCan's Minerals and Metals Sector. CANMET-MMSL is fully accredited under ISO 9001-2001.
- **CSIR Mining Technology** has facilities in Johannesburg and Pretoria, South Africa. Miningtek is recognized for its expertise in mine engineering and leading technical research. Miningtek provides a wide range of technical services to the South African mining industry ranging from mine design and planning to mineral resource management, mine worker safety training, and STD/HIV/AIDS programs for the minerals industry.
- **The CSIRO Division of Exploration and Mining** has laboratories in Perth, Melbourne, Sydney and Brisbane, Australia. CSIRO scientists and technicians are recognized for their research and expertise in mineral exploration geophysics and advanced mineral mapping technologies, as well as mineral database management and geochemistry. CSIRO researchers are also very active in advanced mining techniques, including automation. CSIRO's Division of Land and Water has expertise in the remediation of contaminated environments, catchment and groundwater management, and agricultural land-use management.
- **The Mine Safety Laboratories of NIOSH** (The National Institute of Occupational Safety and Health), as part of the Centers for Disease Control: NIOSH has mine safety research laboratories in Pittsburgh, Pennsylvania, and Spokane, Washington. NIOSH's mandate is to invest in research that benefits mine worker health and safety, and this includes expertise in the disciplines of ground control and mine subsidence, safety, and occupational disease.

Several factors contributed to the establishment of the GMRA. Mining is increasingly a global activity with a number of large multi-national corporations controlling an ever-increasing share of the industry's companies. The GMRA, with its global experience and capabilities, is in a better position to serve the global industry while at the same time fostering the national interest of the partner countries. In addition, mining faces increasingly stringent technical challenges. These arise from such factors as mining deeper, mining less attractive orebodies, mining in remote regions, mining with increasingly strict control and standards of environmental performance, and mining with much attention being paid to the social implications of mine projects. Paradoxically, economic pressures on the industry, together with corporate amalgamation, are drastically reducing the industry's in-house R&D capacity; university research is also suffering from low enrolment in mining schools. The GMRA brings together the already substantial R&D capacity of the four diverse organizations and thus greatly strengthens the overall global research capability.

The GMRA allows the partners to reduce their respective expenses by combining capacity to bring in funds from the private sector. Partners can focus individually on aspects they do best while turning to their partners for support in other areas. As a not-for-profit unincorporated joint venture, the GMRA recovers only the fully loaded costs of carrying out its research. Members of the Board of Directors are the four heads of the partner organizations with Canada currently in the chair from July 1, 2002 to June 30, 2004.

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Environmental Management of the Mining Sector in Zambia (EMMS)

CANMET-MMSL is the executing agency for the four-year CIDA-funded project on Environmental Management in the Mining Sector (EMMS) in Zambia. The goal of the EMMS project is to improve environmental management practices in the mining sector in Zambia, principally by strengthening the institutional capacity of the Mines Safety Department (MSD) of the Ministry of Mines and Minerals Development (MMMD) and other designated institutions to regulate and monitor environmental management, while at the same time building knowledge of environmental management among Zambian mining companies. The project works with other key mining sector institutions such as the Environmental Council of Zambia (ECZ), ZCCM Investment Holding Plc, the University of Zambia, Copperbelt University, and the mining industry.

In this the second year of the project, a Steering Committee meeting was held in June 2002 at which CIDA expressed concern regarding the lack of funding being allocated to the MSD by the Government of the Republic of Zambia (GRZ). While it was planned that emphasis would begin to shift from project establishment and relationship-building toward a longer-term technical training program in year two, CIDA requested that no further training take place until the funding issue was addressed by the GRZ. In order to help address the funding issue, CANMET-MMSL focused mainly on completing a Resource and Revenue Assessment of the Mines Safety Department (MSD). Senes Consultants Ltd. were hired to undertake the assessment, which consisted of a series of consultative meetings and workshops with a wide variety of stakeholders to gather information related to defining appropriate core activities of the MSD, staffing levels and salary requirements (to mitigate staff losses to other organizations), organizational structure, and funding mechanisms. A draft report containing recommendations was completed in December 2002 and will be further discussed at a series of consultative meetings in early 2003.

In anticipation that the funding issue for the MSD would be resolved, CANMET-MMSL initiated a competitive process for a series of standing offers with Canadian consultants to assist in the development and delivery of a technical training program. The tender was advertised in December 2002 and it is expected that the successful consultants will be notified in early 2003.

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Mine Rehabilitation Project in Brazil

Since 1998, CANMET-MMSL has been the delivery agent of a CIDA-funded project in Brazil on mine rehabilitation. Through this project, CANMET-MMSL has managed the transfer of expertise to a Brazilian government laboratory, Centro de Tecnologia Mineral (CETEM), to assist the lab in implementing the application of mined land reclamation by the Brazilian mining industry.

In 2002, discussion, planning and preparations were under way for a conference in Florianopolis, Brazil, in 2003 in order to share the lessons learned from the project with interested stakeholders. The conference will include representatives from CETEM, the Brazilian mining sector and CANME-MMSL, and will feature a variety of presentations on both regulatory issues and technical reclamation projects. The conference will also be an opportunity to showcase both the cooperative relationships between industry and regulators that have developed during the project and the scientific expertise that has developed in Brazil as a result of project activities. Based on the positive results obtained from this project, preliminary discussions are under way for the possible development of a CIDA-funded trilateral project between Canada, Brazil and a third South American country (possibly Bolivia).

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Guyana Environmental Capacity Development Project (GENCAPD)

The GENCAPD project is designed to develop environmental expertise in several of the key institutions involved with the mining sector in Guyana, and to develop a regulatory framework that will promote the sustainable development of Guyana's mineral resources.

This project, initiated in 1998, has been extended to 2004 by the Canadian International Development Agency (CIDA). This was done in order to ensure the industry would participate more actively in the implementation of the mining-related environmental regulations. The industry requested that the government provide more direct hands-on participation at the mining sites (i.e., located in the jungle) by the key mining sector institutions of Guyana, including the Guyana Geology and Mines Commission (GGMC), the Environmental Protection Agency (EPA), the University of Guyana, and the Ministry of Health.

During 2002, the project focused on the following areas:

- **Policy and Regulation**: To support legislation, the project completed the field work and analysis concerning mercury related to gold amalgamation, with the support of the above-mentioned institutions, and concluded that mercury was naturally occurring in soils. Hydraulicking, rather than amalgamation, was responsible for the methylation of mercury at downstream mining sites. In this order, providing economical dry mining techniques assured solutions to two major environmental issues: the mobilization of mercury and the constriction of turbidity plumes. The Guyana Ministry of Health participated in the project and demonstrated that community intoxication by mercury was not related to the amalgamation technique. These results were presented during the GGMC Mining Week.

- **Industry Practice**: Although mercury is naturally occurring in the clays of the Guyana Shield, the burning of amalgam is a health hazard during the refinery process. The project designed an affordable retort based on research done by the GGMC and the University of Guyana. Local enterprise provided enough retorts for the Guyana Gold and Diamonds Miners

Association (GGDMA) to distribute to its members, with the appropriate training on how to use the retorts. Amerindian community miners were supplied with the retorts by the GGMC. Finally, training of the mines inspectors was provided by CANMET, and Amerindian rangers were trained as mines inspectors.

- **Institutional Development**: The Institute of Applied Sciences and Technology of the University of Guyana was audited by the project for quality assurance of its analysis. Manuals and protocols were written accordingly. The project provided the GGMC with the hardware support for data analysis and communication, through the Internet, with the mining industry's scientific community. Finally, the GGDMA has included, as part of its staff, an environmental officer who reports directly to the permanent secretary of the association.

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International Workshop on Life-Cycle Assessment and Metals

Should the attributes of a "green product" containing metals be based on the recycled metal content or on its recyclability? Future metal scarcity is an important issue among environmentalists, but is it a concern for the specialist in the field of mineral economics? Do you think that throwing a nickel into the Rhine River has the same potential risk to the aquatic ecosystem as 15 tonnes of 1,4 dichlorobenzene, the white puck used in urinals? Because of the international context, assessment outcomes may have an impact on the ability of metal products to access foreign markets.

In order to create a bridge between the life-cycle assessment (LCA) experts and various scientific and technology experts interested in metals, NRCan organized a workshop on LCA and metals. The workshop was sponsored by the United Nations Environment Programme (UNEP), the Society of Environmental Toxicology and Chemistry (SETAC), the Asia-Pacific Economic Cooperation-Expert Group on Minerals and Energy Exploration and Development (APEC-GEMEED), and the International Council on Mining and Metals (ICMM). There was also participation from the steel and aluminum sectors. The workshop was held in Montréal from April 15 to 17, 2002, and 60 experts from 17 countries participated.

The workshop was an opportunity to present and review the information that has been obtained on the mining, production, use and disposal of base metals, and to compare it with existing LCA methodologies in order to evaluate gaps and enhance relevancy. A short list of the recommendations of the workshop are captured under three themes: life-cycle inventory, metal mining, and human and environmental toxicity of metals.

In conclusion, new relations have been established and some of the recommendations are incorporated into the UNEP/SETAC Life-Cycle Initiative.

The proceedings will be published by SETAC in 2004. Abstracts and presentations are available on the Internet at www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/enviro/lifecycle/default.htm.

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Microseismic Monitoring Associated with a Tunnel Excavation in a Clayey Formation (France and Canada)

In France, the safety of operations related to the storage of nuclear waste is part of the expertise of the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) under the auspices of the Autorité de Sûreté Nucléaire (ASN). Clayey formations are considered to be potential geological barriers for the deep storage of nuclear waste because of such characteristics as low permeability and retention of radioelements. Consequently, the application of geophysical methods (non-destructive methods for the analysis of disturbances induced by excavation in clayey formations) will be unavoidable for analysis (and quantification) of in situ damage.

Since October 2002, the IRSN and CANMET-MMSL have been working together to install and operate a network of microseismic sensors for a seismic survey of a rock mass disturbed by the excavation of a tunnel. Hence, this work will make it possible to evaluate the capabilities of seismic methods to analyze the damage caused by such an excavation.

Microseismic monitoring of a tunnel excavation at the Tournemire site will make it possible to locate with precision the acoustic emissions produced by local readjustment of the stress field. This monitoring, completed with seismic surveys at time intervals of a few months, will allow the thickness of the zone mechanically damaged and its spatial and temporal evolution to be quantified. In addition, analysis of the source of these acoustic emissions will make it possible to identify the types of movement along the discontinuities.

The IRSN selected CANMET-MMSL on the one hand because of the expertise it has developed over the years in evaluating, in collaboration with Atomic Energy of Canada Limited, damage to underground excavations at its Underground Research Laboratory (URL) in Pinawa, Manitoba, and, on the other hand, because of its experience related to microseismicity in clayey formations, acquired during microsiesmic monitoring of oil sand reservoirs. CANMET-MMSL's involvement centres on the design of the microseismic network, the installation of special amplifiers and acquisition systems, the installation of the microseismic network at the Tournemire site, and technical and scientific assistance with microseismic data recorded during this project.

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Notes: (1) Information in this review was current as of December 31, 2003. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002CMY_e.html.

NOTE TO READERS

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Canada's Global Mining Presence

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GLOBAL MARKET FOR MINERAL EXPLORATION

In 2002, the value of exploration programs planned around the world by companies of all sizes for precious metals, base metals and diamonds stood at an estimated $3.0 billion (US$1.9 billion), down by more than 12% from the $3.4 billion (US$2.2 billion) planned the previous year.[1] Compared with 2001, the value of exploration programs planned worldwide for 2002 was lower in roughly two thirds of countries where companies operate. Only in Russia, Mongolia and Finland was there an increase in exploration programs of more than $10 million expected from 2001 to 2002. In contrast, there were seven countries where year-over-year decreases in programs of $30 million or more were expected to occur; in three of these countries, decreases of $50 million or more were likely.

WORLD'S LARGER COMPANIES

Global trends in mineral exploration are based on data for the world's larger mining companies.[2] These companies are defined here as those with annual exploration budgets of more than $4.7 million in 2002 (current US$3 million annually). The larger companies are the only ones for which there are consistent data on worldwide exploration activities spanning a period of 11 years. In 2002, 96 companies based around the world each planned to spend more than $4.7 million on exploration. In 2001, 98 companies had planned to spend an equivalent amount; in 1997, the number stood at a record 279.

During 2002, the world's larger companies were expected to undertake exploration programs with a combined value of $2.1 billion (US$1.4 billion) in 94 countries, 5 countries fewer than in 2001.

The world's larger companies represent only about 15% of the 724 companies of all sizes that were expected to be active in mineral exploration worldwide during 2002. However, these companies account for roughly 80% of the value of all mineral exploration programs carried out around the globe.

On a commodity basis, the larger companies account for over 80% of the value of programs aimed at base metals and diamonds; for more than 75% of those aimed at gold; and for almost 70% of those aimed at platinum group metals (PGMs). On a regional basis, the larger companies account for over 85% of the programs planned for Europe and the former Soviet Union (FSU), and for Latin America; 80% or more of those planned for Africa and the Middle East, and for the United States; and roughly 70% of those planned for Asia-Pacific and for Canada.

LARGER CANADIAN-BASED COMPANIES

There are more mineral exploration companies based in Canada than in any other country (Figure 1). In spite of generally low prices for mineral commodities in recent years and the difficulty for many companies that have no producing mines to raise capital, 37 Canadian-based companies each planned to spend $4.7 million or more on mineral exploration in 2002, up from 32 in 2001.

In 1996, mining companies listed on Canadian stock exchanges raised a record amount of equity capital.[3] As a result, 141 Canadian-based companies had each planned to spend, in 1997, the equivalent of $4.7 million on mineral exploration programs around the world. That year their aggregate budgets for exploration, adjusted for inflation, reached a record value of almost $2.1 billion.

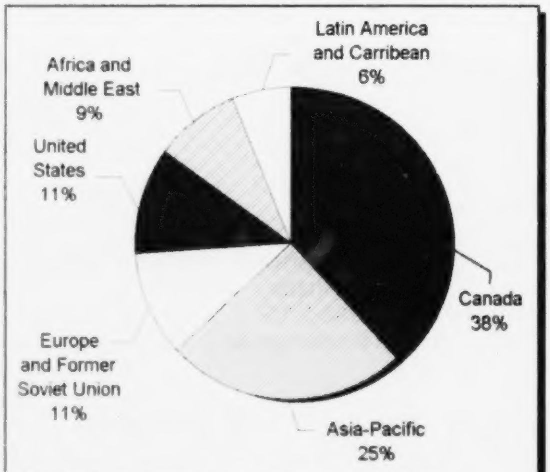
In 2002, the total value of the exploration programs that the larger Canadian-based companies planned to undertake in Canada and elsewhere around the world stood at $670 million (Figure 2), or down by 12% from almost $760 million budgeted in 2001. About two thirds of the decrease in these Canadian exploration budgets from 2001 to 2002 was expected to occur abroad.

The programs that the larger Canadian-based companies planned to undertake during 2002 represent 32% of all larger-company exploration programs for the entire world. These Canadian companies account for the dominant share, by far, of all worldwide mineral exploration activity. Companies based in Africa account for 17% of the larger-company activity worldwide, while companies based in Europe and those based in Australia each account for 16%. In 1997, the exploration programs of the larger Canadian-based companies accounted for a record 35% of the value of all mineral exploration activity planned worldwide.

The larger Canadian-based companies typically budget less individually for exploration programs than the industry average worldwide. In 2002, the exploration budgets of the larger Canadian-based companies had a mean of $18.2 million and a median of $7.5 million compared with global averages of $22.2 million and $9.1 million, respectively. In 2002, the mean of the budgets of the larger Canadian-based companies decreased by more than $5 million compared with that of the previous year.

Although, on a company-by-company basis, there can be a significant variation between budgets and expenditures, aggregate exploration budgets generally provide a reliable estimate of the total amount actually spent in the field worldwide. In the case of the larger Canadian-based companies, actual expenditures in 1999 were about 7% lower than budgeted, roughly the same departure as observed in the previous year.[4]

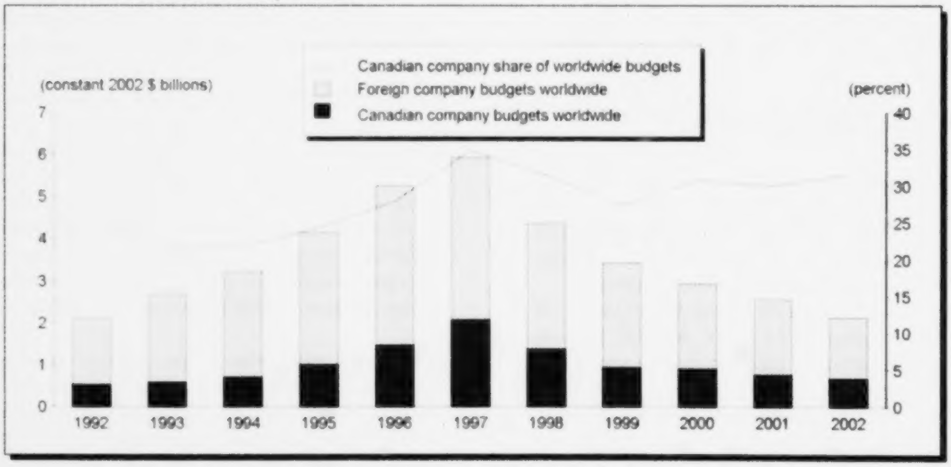
Figure 1
Distribution of the World's Larger Exploration Companies, by Domicile, 2002



Based on 96 companies with budgets of at least $4.7 million (US$3 million) for precious-metal, base-metal or diamond exploration.

Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

Figure 2
Exploration Budgets of the World's Larger Companies, by Origin, 1992-2002
Companies with Worldwide Budgets of at Least $4.7 Million in 2002 for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: The worldwide exploration budgets of companies that intended to spend less than 4.7 million (US$3 million) in 2002 are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of more than 6100 mineral properties (Figure 3) located in Canada and in more than 100 other countries around the world.[5] Most of this portfolio consists of properties at the early stages of exploration. The number of properties held worldwide at the end of 2002 increased by about 400, or by more than 7%, compared with the number held at the end of the previous year. This increase occurred mainly in Canada and reflects, in part, the increasing recognition by the mining industry of the diamond and PGM potential in this country.

LARGER-COMPANY EXPLORATION MARKET IN CANADA

In 2002, the larger-company mineral exploration market in Canada was valued at $330 million, down by $35 million, or 10%, from roughly $365 million in 2001 (Figure 4). Only in Australia and the United States were aggregate exploration programs expected to experience larger year-over-year reductions. For the first time in a decade, Canada, in 2002, became the country where the global mineral exploration industry is the most active. Australia held that position from 1992 through 2001. The smaller companies are important contributors to mineral development in Canada and elsewhere around the world, but their activities are not addressed specifically here.

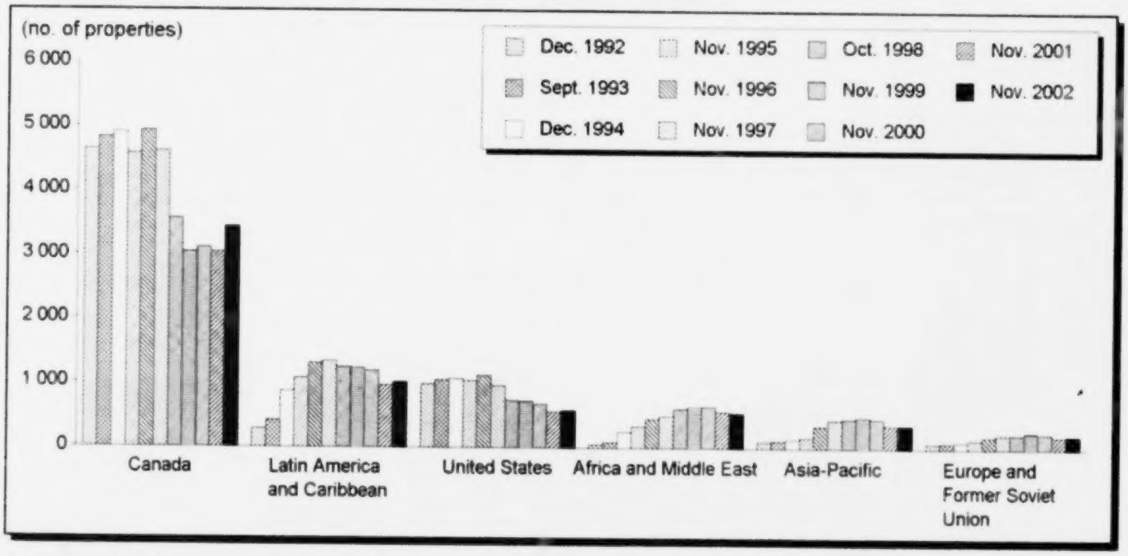
In 2002, 42 of the world's larger domestic-based or foreign-based companies planned to explore for minerals in Canada, up from 38 in 2001. More than 15% of the exploration efforts of all of the world's larger companies were expected to take place in Canada in 2002, up from 14% in 2001 (Figure 5). The proportion of all global exploration efforts taking place in Canada stood at about 11% during each of the previous three years. Before the large increase in exploration activity that occurred in developing countries starting in the early 1990s, the proportion of all worldwide mineral exploration activity taking place in Canada stood at 18%.

At the end of 2002, there were more than 3400 mineral properties with recent exploration activity in this country[6] (Figure 3).

Figure 3

Canadian Mineral Property Portfolio Worldwide, by Region, 1992-2002

Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1992-97 and InfoMine db for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Note: The decrease in properties in Canada after 1997 is due, in part, to the implementation of database features that make it possible to exclude many inactive properties.

Larger Canadian-Based Companies in Canada

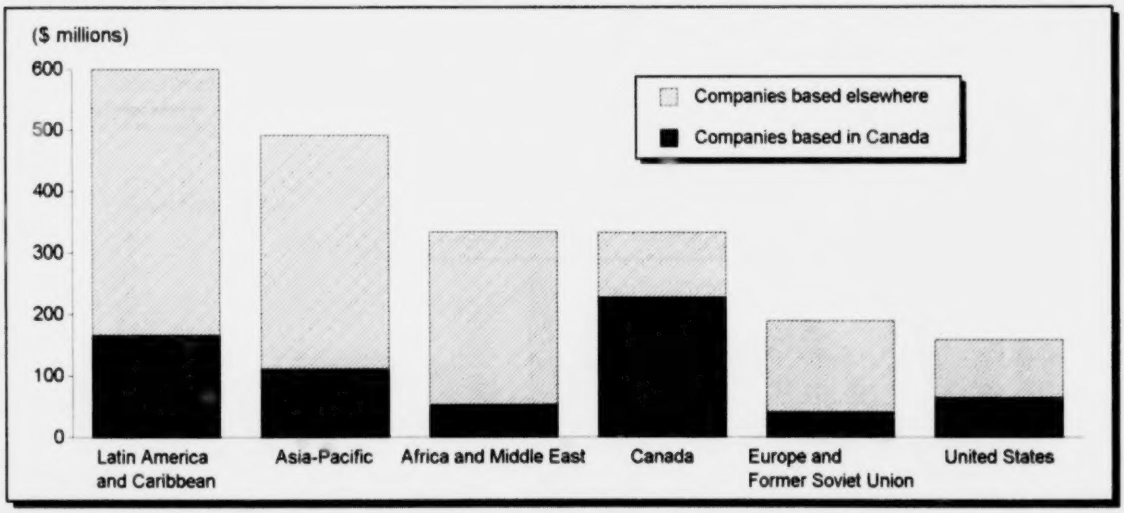
In 2002, 28 of the larger Canadian-based companies allocated, in total, \$228 million for mineral exploration in Canada. Their exploration budgets were up by more than \$20 million, or 10%, from the \$207 million they allocated in 2001.

For the third year in a row, Canadian companies planned to spend more on mineral exploration in Canada than in all of Latin America. From 1995 to 1999, Canadian-based companies had spent more in that region of the world than in this country.

The larger Canadian-based companies control 69% of the larger-company mineral exploration market in Canada. Because mineral exploration is such an international enterprise, the dominance of exploration programs by domestic firms is relatively uncommon. In 2002, there were only six other countries where domestic companies controlled more than half of the larger-company market for mineral exploration: Australia and Sweden (52% each), Brazil (59%), Russia (66%), South Africa (77%), and Japan (100%). Although, during 2002, the larger-company market for mineral exploration was valued at almost \$330 million in Australia, at over \$140 million in Brazil, and at roughly \$80 million in each of South Africa and Russia, it was valued at less than \$20 million in Sweden and at less than \$5 million in Japan.

With increasing globalization, the share of the domestic exploration market controlled by Canadian-based companies has fallen gradually as foreign-based companies have increased the amount of activity that they undertake in this country. In 1992, Canadian-based companies controlled 80% of the larger-company mineral exploration market in Canada. However, by 2000, they controlled only two thirds of it. Since the early 1990s, the share of the exploration market controlled by the larger domestic firms has also fallen gradually in the United States and Australia. Although Canadian companies operate all over the world, Canada remains the country where they conduct, by far, the largest proportion of their global mineral exploration programs (Figure 6).

Figure 4
Exploration Budgets of the World's Larger Companies for Selected Regions of the World, 2002
Companies with Worldwide Budgets of at Least \$4.7 Million for Precious-Metal, Base-Metal or Diamond Exploration



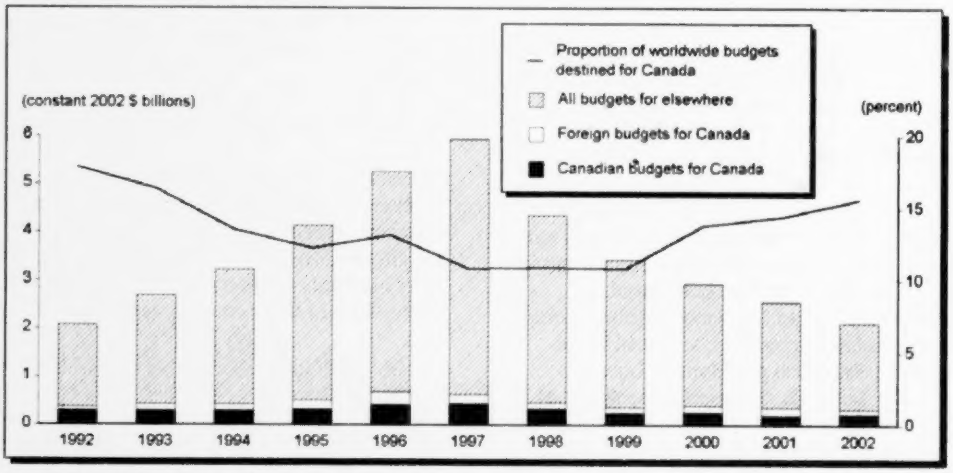
Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

Notes: The worldwide exploration budgets of companies that intended to spend less than \$4.7 million (US\$3 million) in 2002 are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

Figure 5

Exploration Budgets of the World's Larger Companies for Canada and Elsewhere, 1992-2002

Companies with Worldwide Budgets of at Least $4.7 Million in 2002 for Precious-Metal, Base-Metal or Diamond Exploration



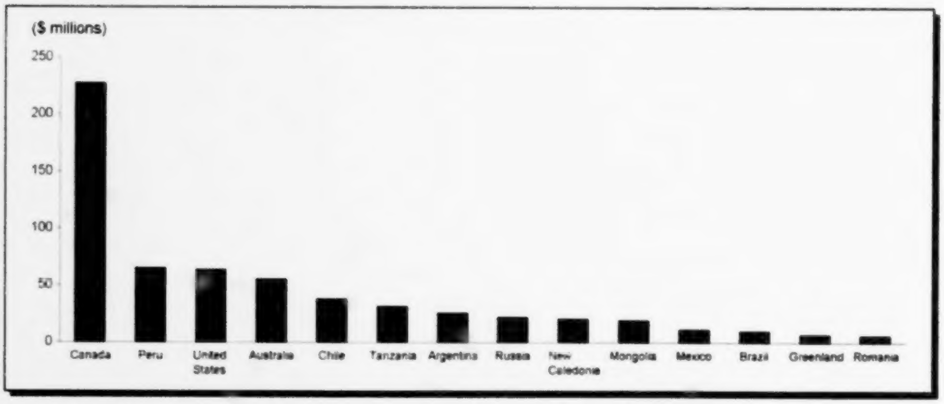
Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

Notes: The worldwide exploration budgets of companies that intended to spend less than $4.7 million (US$3 million) in 2002 are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

Figure 6

Exploration Budgets of the Larger Canadian-Based Companies, 2002 - Countries Accounting for 90% of Canadian Budgets

Companies with Worldwide Budgets of at Least $4.7 Million for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

Notes: The worldwide exploration budgets of companies that intended to spend less than $4.7 million (US$3 million) in 2002 are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

Foreign-Based Companies in Canada

During 2002, 14 of the larger foreign-based companies planned to spend, in total, almost $105 million on mineral exploration in Canada (Figure 5). This represents more than 30% of all activity planned for this country; however, in 2001, that proportion was 45%. Compared with the previous year, the budgets of foreign-based companies for Canada decreased by more than $55 million in 2002. This reflects, in part, the natural progression of mineral development activity from exploration to capital investment, and to mineral production, particularly in the case of diamonds.

In 2002, the larger foreign-based companies active in mineral exploration in Canada included BHP Billiton Limited-BHP Billiton Plc and WMC Limited, both based in Australia; Echo Bay Mines Ltd., Newmont Mining Corporation, and Phelps Dodge Corporation, all based in the United States; Anglo American plc, Boliden Limited, Lonmin Plc, and Rio Tinto plc, all based in Europe; Anglo American Platinum Corporation Limited, AngloGold Limited, the De Beers group, and Impala Platinum Holdings Limited (IMPLATS), all based in South Africa; and the Mexican mining consortium, Grupo México S.A. de C.V.

In 2002, De Beers reported an exploration budget for Canada of more than $40 million. This represents the largest budget reported by all domestic and foreign companies operating in this country. BHP Billiton, whose budget for Canada was $28 million, had the second largest budget. De Beers' entire exploration budget for Canada is aimed at diamonds, as is 70% of BHP Billiton's. These two companies alone accounted for half of all larger-company budgets for diamond exploration in Canada in 2002.

LARGER CANADIAN-BASED COMPANIES ABROAD

In 2002, the larger Canadian-based companies planned to spend over $445 million on mineral exploration outside of Canada (Figure 4). Their budgets were down by $105 million, or by almost 20%, from the more than $550 million that they had planned to spend in 2001.

Two thirds of the worldwide budgets of the larger Canadian-based companies were allocated to programs abroad in 2002, somewhat less than in 2001. The foreign programs of the larger Canadian-based companies, as a proportion of their domestic and foreign programs combined, peaked at over 78% in 1997. In 1992, that proportion was only about 40%.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of almost 2700 mineral properties located abroad (Figure 3), about the same as in the previous year. Foreign properties now represent slightly more than 40% of the total mineral property portfolio held by all companies listed in Canada, down from about half in 2001. In 1992, that proportion was only one quarter.

Apart from the United States, where companies of all sizes listed on Canadian stock exchanges have a substantial mining presence, about 30 other nations, spread across the globe, account for most of the balance of their foreign mineral property portfolio (Figure 7).

Canadian companies have interests in over 200 mines, smelters, refineries, plants under construction, or other advanced mineral development projects (Figure 8) in roughly 60 foreign countries.[7] Canadian companies also have hundreds of other projects at the early stages of exploration in these countries and in more than 40 others.

At the beginning of 2003, there was at least US$54 billion worth of new copper, diamond, gold, iron, nickel, PGMs, silver or zinc mining projects, each with a value of at least US$65 million, either at the planning, feasibility, construction or deferred stage of development in Canada or elsewhere around the world[8] (Figure 9). Although only 9% of the total value of those projects was expected to be invested in this country, Canadian companies were expected to participate in roughly 30% of all this current mining investment around the globe.

The activities of Canadian mining companies in Canada and abroad have fostered the development in this country of over 2200 suppliers of specialized mining goods and services. Many of these suppliers, such as some drilling companies (Figure 10), export their products all over the world.[9]

United States

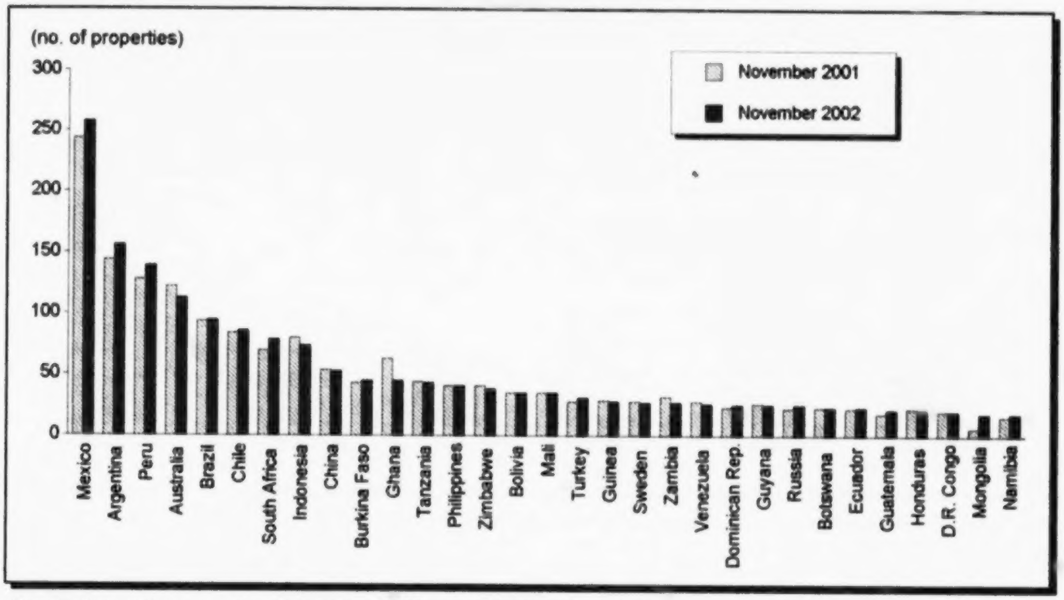
In 2002, the larger-company mineral exploration market in the United States was valued at almost $160 million (Figure 4), or roughly 8% of the $2.1 billion larger-company market worldwide. Larger-company budgets for the United States were down by $40 million compared with those of the previous year. Eleven of the larger Canadian-based companies planned to spend, in total, almost $65 million in the United States, down from $110 million in 2001.

In 2002, the share of the larger-company exploration market held by Canadian-based companies in the United States fell to 45%, down from 55% the previous year. Since the early 1990s, Canadians have increased their share of the exploration market in the United States almost every year. The United States ranks third in terms of countries where Canadian companies are the most active in mineral exploration (Figure 6).

Figure 7

Canadian Mineral Property Portfolio Abroad, 2001 and 2002 – Countries Accounting for 80% of Canadian Holdings Located Outside the United States in 2002

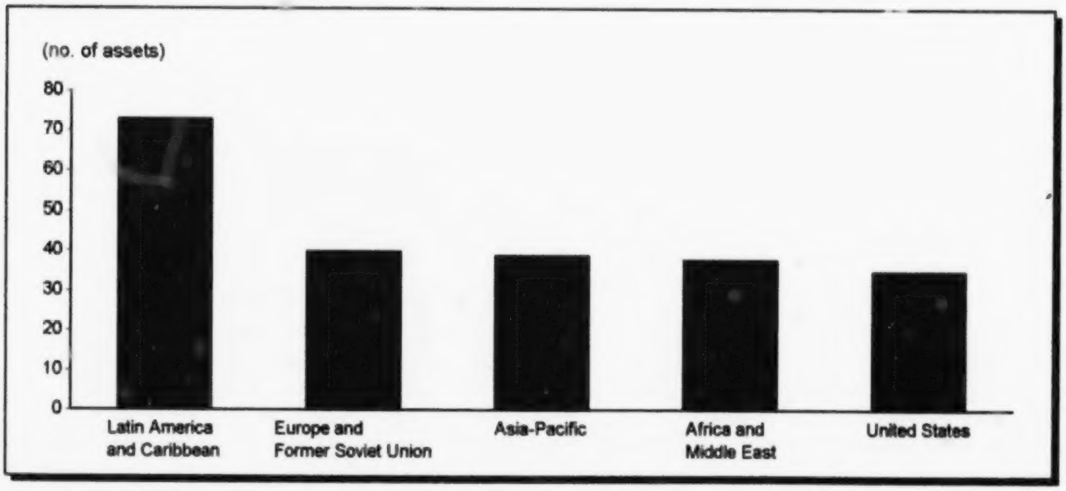
Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on InfoMine db, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

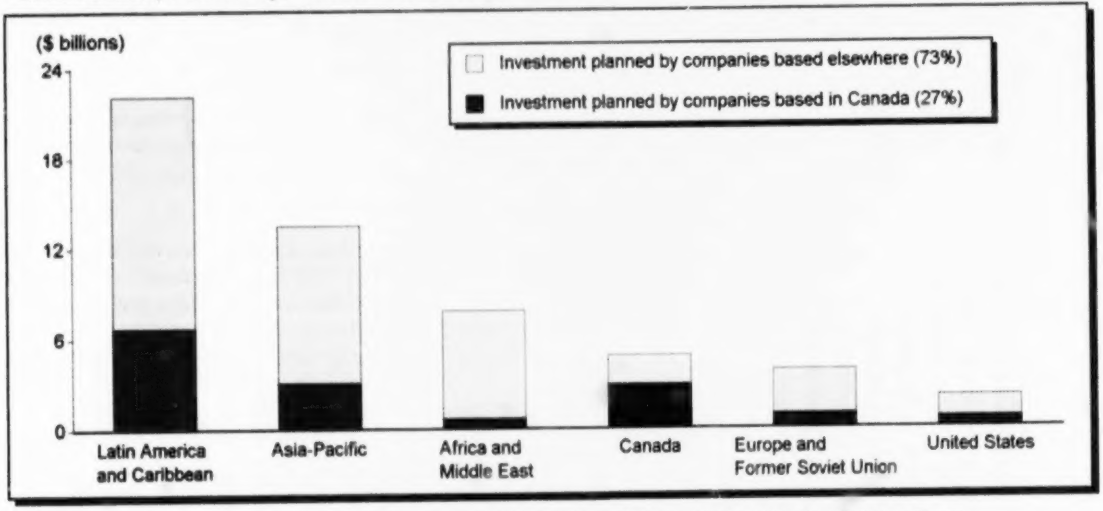
Figure 8

Mines, Refineries, Smelters and Advanced Projects Abroad in Which Canadian Companies Have an Interest



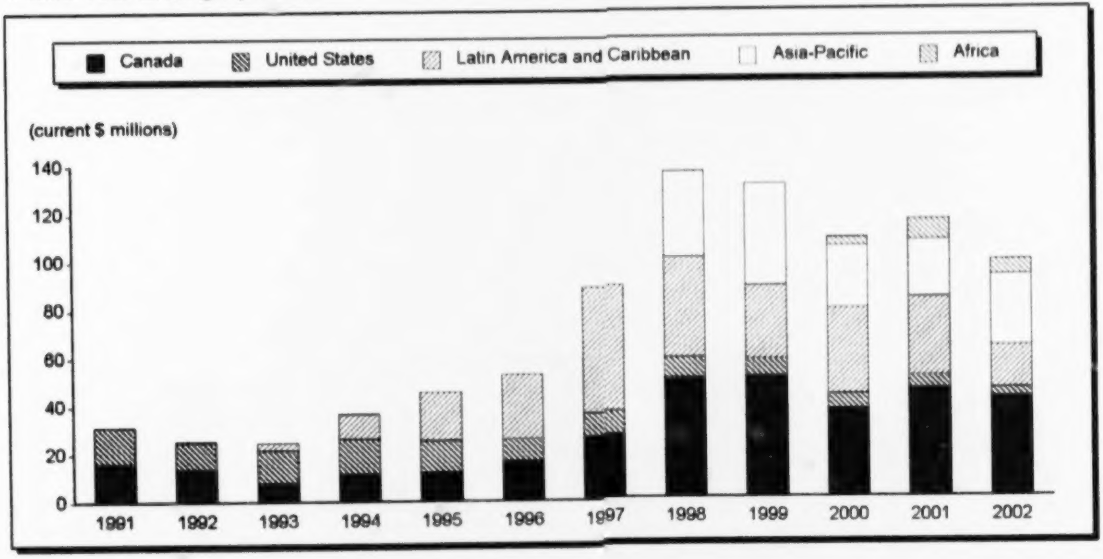
Source: Natural Resources Canada, based on company reports available in June 2000.

Figure 9
New Copper, Diamond, Gold, Iron, Nickel, PGM, Silver and Zinc Mining Projects Each Requiring an Investment of US$65 Million or More, January 2003
Construction, Feasibility, Planned or Deferred Status – Total of US$54 Billion



Source: Natural Resources Canada, based on *Engineering & Mining Journal*, January 2003, after Raw Materials Group, Stockholm.

Figure 10
Major Drilling Group International Inc., Drilling Revenues by Region, 1992-2002
Fiscal Year Ending April 30th



Source: Natural Resources Canada, based on company reports.
Note: The company is based in Moncton, New Brunswick.

During 2002, Canadian companies were expected to spend $20 million more on exploration in the United States than U.S. companies. American companies have budgeted progressively decreasing amounts for mineral exploration in their country most years since the early 1990s. Although U.S. companies accounted for almost 60% of the value of all exploration programs in their country in 1992, their activities represented less than 30% in 2002.

In late 2002, companies of all sizes listed on Canadian stock exchanges held interests in about 575 mineral properties in the United States (Figure 3), roughly the same number that they held at the end of the previous year. In 2000, they had projects located in 22 states, but their efforts were concentrated mainly in the western part of the country in Nevada, Alaska, California, Arizona, Montana, Idaho, Wyoming, Colorado, Washington, Utah and South Dakota in decreasing order.[10] That year, Nevada alone accounted for more than 250 of their mineral properties, or almost 40% of the total Canadian portfolio in the United States.

Although Canadian companies have considerably expanded their activities in Latin America, Africa and Asia since the early 1990s (Figure 3), the United States is likely to remain, for the foreseeable future, the foreign country where they hold their largest portfolio of mineral properties. At the end of 2002, the United States accounted for over 20% of all properties held abroad by companies of all sizes listed on Canadian stock exchanges.

Of all the Canadian-based companies, Placer Dome Inc., NovaGold Resources Inc., Formation Capital Corporation, Barrick Gold Corporation, Kinross Gold Corporation, and Teck Cominco Limited planned the largest mineral exploration programs in the United States during 2002. Together these companies planned to spend over $50 million, equivalent to 90% of the value of all Canadian programs for that country.

In 2002, Placer Dome planned to spend more than $16 million on exploration in the United States, mainly for gold in Nevada. The company planned to spend roughly $9 million at the Cortez (South Pipeline) gold mine and at Getchell (Getchell, Turquoise Ridge and N-Zone gold deposits). It planned to spend the remaining $7 million at the South Carlin gold project, also in Nevada. NovaGold planned to spend more than $12 million, about three quarters of it drilling at the Donlin Creek gold deposit in Alaska. Resources at Donlin Creek are estimated at roughly 120 Mt grading 4.1 g/t gold. Formation Capital planned to spend $9 million to assess the feasibility of bringing into production a cobalt deposit located near Salmon, Idaho. Resources on that property are estimated at roughly 3 Mt grading 0.6% cobalt, 0.45% copper and 0.6 g/t gold.

Barrick planned to spend much of its almost $7 million budget for the United States on further exploration for gold at the Goldstrike operation (Betze-Post and Meikle mines, and Rodeo deposit), the Marigold mine, the Round Mountain mine, the Rossi deposit, and the Dee property, all in Nevada. Kinross planned to spend much of its $6 million budget for the country at or in the vicinity of the Fort Knox open-pit gold mine in Alaska. Teck Cominco planned to spend more than $3 million of its $5 million budget for the United States evaluating the gas-bearing shale of the Kuna Formation as a potential source of fuel for the Red Dog mine, also in Alaska.

Latin America and the Caribbean

In 2002, the larger-company mineral exploration market in Latin America and the Caribbean was valued at $600 million (Figure 4), or 28% of the $2.1 billion larger-company market worldwide. During 2002, the larger Canadian-based companies planned to spend over $154 million in the region, down by $25 million, or 13%, compared with 2001.

Over the 12-year period 1991-2002, the global mining industry invested more than US$7.2 billion (current dollars) in mineral exploration in Latin America and the Caribbean. Companies listed on Canadian stock exchanges accounted for one third of that investment.

After Canada, Latin America has become the region of the world where Canadian companies are the most active in mineral exploration. However, from 1995 to 1999, Canadian companies spent more on mineral exploration in Latin America and the Caribbean than they did in this country.

In 2002, Canadian companies held more than 27% of the larger-company market in Latin America and the Caribbean. The value of Canadian exploration programs stood a close second to those of companies based in the region. The share of the exploration market held by local companies stood at 31% in 2002, roughly the same as in the previous two years; in 1994, local companies held less than 15% of the market in the region.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in about 1000 mineral properties in Latin America and the Caribbean, about the same as in 2001. Since 1996, the total number of mineral properties held by Canadian companies in the region has exceeded the number held in the United States (Figure 3).

Mexico

In 2002, the larger-company mineral exploration market in Mexico was valued at $68 million, or 3% of the $2.1 billion larger-company market worldwide. Larger-company budgets for Mexico were almost 20% lower than those in the previous year.

Mexico is one of the relatively few countries where domestic companies carry out a significant proportion of mineral exploration programs, even if it is not the dominant share. Together the Mexican companies Industrias Peñoles, S.A. de C.V. and Grupo México were expected to undertake roughly one quarter of the exploration programs planned for the country during 2002.

Mexico ranks fourth in Latin America and eleventh in the world in terms of countries where Canadian companies are the most active in mineral exploration (Figure 6). Five of the larger Canadian-based companies planned exploration programs in Mexico in 2002. These companies were expected to spend, in total, about $7 million there.

Gammon Lake Resources Inc. planned to spend $5 million at the Ocampo gold-silver project in the state of Chihuahua. A preliminary study, completed in April 2002, estimated the cost of building a combined open-pit and underground mine at Ocampo at US$39 million. The mine would produce 120 000 oz of gold and 5.3 million oz of silver annually over a period of more than eight years. Measured and indicated resources at Ocampo are estimated at 21.7 Mt grading 1.44 g/t gold and 57 g/t silver.

In 2002, Teck Cominco budgeted $3.9 million for Mexico. The company planned to spend $0.6 million to further evaluate the San Nicholas polymetallic deposit located in the state of Zacatecas. Towards the end of 2001, the company completed a feasibility study that estimated the capital cost of building a 15 000-t/d open-pit mine at San Nicholas at almost US$246 million. Resources included in the mine plan are estimated at 65 Mt grading 1.32% copper, 2.04% zinc, 0.53 g/t gold and 32.1 g/t silver. However, San Nicholas is unlikely to produce until metal prices improve significantly.

Teck Cominco also planned to spend $0.4 million to further assess the Los Filos deposit located in the state of Guerrero. Los Filos contains measured, indicated and inferred resources estimated at 28 Mt grading 2.02 g/t gold. The company also planned to spend a further $1.7 million on the Morelos North gold project located in proximity to Los Filos.

Mexico is one of the countries where the smaller Canadian companies are spending roughly as much on mineral exploration as their larger Canadian counterparts. At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in almost 250 mineral properties in Mexico, about the same as in 2001.[10]

South America

In 2002, the larger-company mineral exploration market in South America was valued at over $475 million, or more than 20% of the $2.1 billion larger-company market worldwide.

Twelve of the larger Canadian-based companies planned to spend, in total, over $150 million in the region, about the same as in the previous year. Their programs accounted for 30% of all mineral exploration activity in South America. Canadian companies held the dominant share of the mineral exploration market in Peru, Chile and Argentina. These countries rank second, fifth and seventh, respectively, in terms of countries where Canadian companies are the most active in mineral exploration (Figure 6).

Barrick is among the largest investors in mineral exploration in South America. In 2002, Barrick was expected to spend almost $58 million in Peru, more than $21 million in Argentina, and more than $18 million in Chile.

Barrick's program for Peru was the largest for the country, accounting for almost 40% of all larger-company exploration programs expected there in 2002. The company planned to spend most of its budget for Peru at the Alto Chicama gold deposit that was discovered in April 2002 and where proven and probable oxide reserves are estimated at 121 Mt grading 0.054 oz/t gold. The capital cost of building a 500 000-oz/y mine at Alto Chicama is estimated in the range of US$300 million to US$350 million. The company planned to complete a feasibility study during 2003. Alta Chicama is expected to start producing gold in 2005.

As in the case of Peru, Barrick's program for Argentina was also the largest planned for that country, accounting for almost 40% of all exploration activity expected there in 2002. Barrick's program for Chile was the second largest for that country, representing roughly 20% of all activity planned there during the year. Barrick is spending most of its exploration budget for Argentina and Chile on the Pascua-Lama deposit, which straddles the border of both countries, and at the nearby Veladero deposit in Argentina.

At Pascua-Lama, the capital cost of building an 800 000-oz/y open-pit gold mine has been estimated at roughly US$1.2 billion. Proven and probable resources there are estimated at 296 Mt grading 0.057 oz/t gold. Pascua-Lama is expected to start producing gold in 2008.

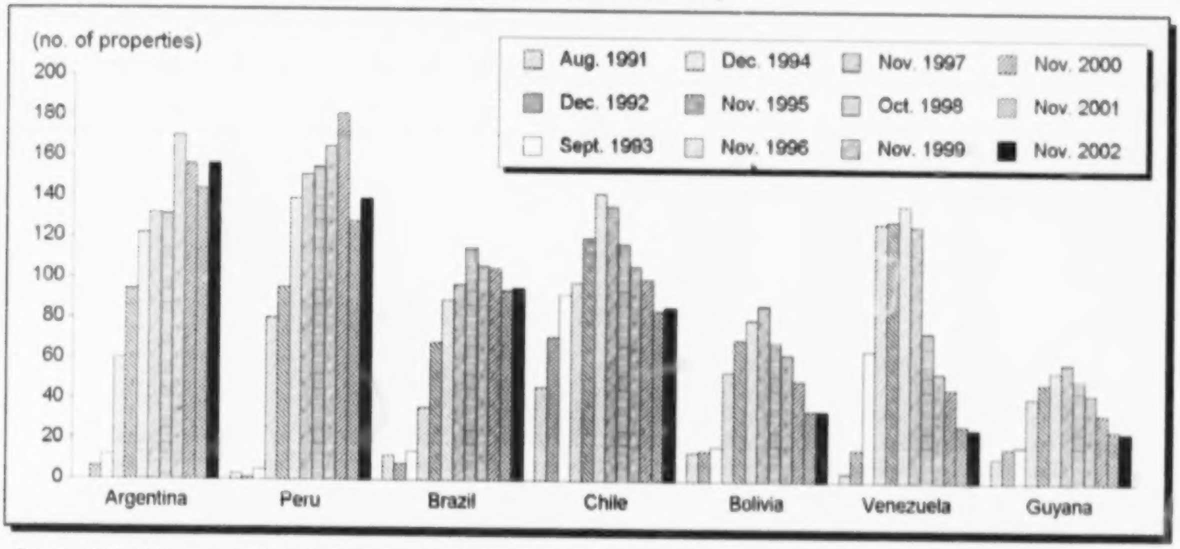
At Veladero, a feasibility study completed in the third quarter of 2002 estimated the cost of building a 530 000-oz/y gold mine that would produce for a period of 13 years at US$425 million. Proven and probable resources are estimated at 254 Mt grading 0.037 oz/t gold. Production is expected to start in 2006.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in over 600 mineral properties throughout South America, about the same as in the previous year. They held more than 150 properties in Argentina, almost 140 in Peru, more than 75 in each of Brazil and Chile, about 30 in Bolivia, and about 25 in each of Venezuela, Guyana and Ecuador (Figure 11).

Figure 11

Canadian Mineral Property Portfolio in South America, 1991-2002 – Countries Accounting for 90% of Canadian Holdings in 2002

Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Central America

In 2002, the larger-company mineral exploration market in Central America was valued at roughly $6 million, or less than 1% of the $2.1 billion larger-company market worldwide. None of the larger Canadian-based companies reported exploration programs in the region.

However, Central America is one of the regions of the world where the smaller companies dominate mineral exploration. In 2002, the smaller Canadian-based companies were expected to undertake more than 80% of the $13 million smaller-company exploration programs planned for the region.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in about 80 mineral properties throughout Central America. They held 15 or more in each of Guatemala, Honduras and Panama (Figure 12).

Caribbean

In 2002, the larger-company mineral exploration market in the Caribbean was valued at about $0.2 million, or less than 1% of the $2.1 billion larger-company market worldwide.

None of the larger Canadian-based companies reported exploration programs for the Caribbean. However, as was the case in Central America, the smaller Canadian-based companies dominated mineral exploration in the Caribbean during 2002.

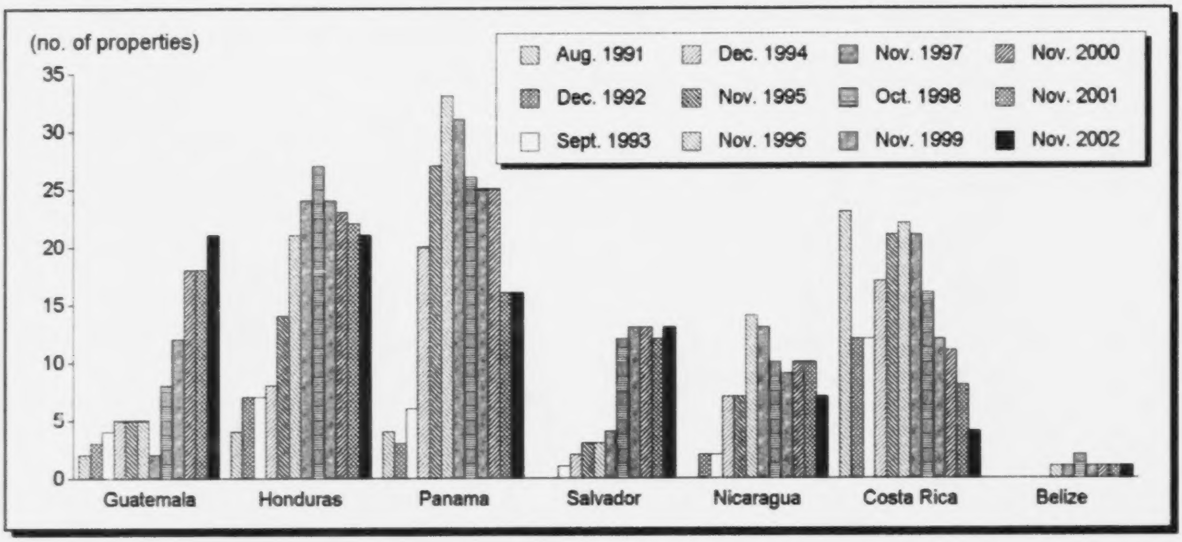
At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in roughly 40 mineral properties in the Caribbean, most of them in the Dominican Republic.

Europe and the Former Soviet Union

In 2002, the larger-company mineral exploration market in Europe and the former Soviet Union (FSU) was valued at $190 million (Figure 4), or almost 9% of the $2.1 billion larger-company market worldwide. The market for exploration in the region apparently grew by $55 million compared with 2001, but this was due in large part to information on activity in the region that became available for the first time in 2002.

The larger Canadian-based companies planned to spend $40 million in the region, equivalent to roughly 20% of the market. The value of Canadian programs in 2002 was $10 million less than in 2001.

Figure 12
Canadian Mineral Property Portfolio in Central America, 1991-2002
Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in 200 mineral properties in Europe and the FSU (Figure 3), about the same as in 2001.

Western Europe

In 2002, the larger-company mineral exploration market in western Europe was valued at almost $80 million, or roughly 4% of the $2.1 billion larger-company market worldwide. The market in the region grew by $15 million compared with the previous year. The larger Canadian-based companies planned to spend almost $18 million in western Europe, equivalent to more than 10% of the market. Canadians were expected to carry out all of the exploration programs planned for Greenland and Norway.

In Greenland, Crew Development Corporation planned to spend $7 million on advanced exploration at the Nalunaq high-grade, narrow-vein gold deposit. A feasibility study, completed in August 2002, estimated the cost of a 94 000-oz/y underground mine that would produce over a period of about four years at US$9.7 million. Measured and indicated resources at Nalunaq are estimated at 483 900 t grading 25.5 g/t gold. Nalunaq will be the first new mine in Greenland in over 30 years and the first-ever gold mine in that country. Construction was scheduled to begin in May 2003.

In Norway, Falconbridge Limited planned to spend about $0.15 million on grass-roots exploration for base metals.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in more than 90 mineral properties in western Europe. They held roughly 30 in Sweden, 15 in Greenland, and 10 in each of Portugal and Spain (Figure 13).

Eastern Europe

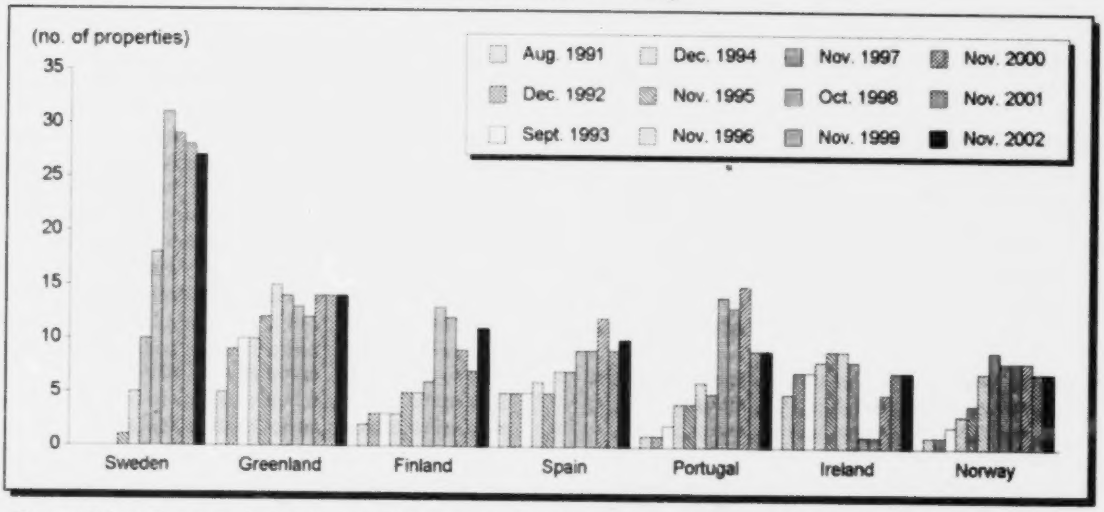
In 2002, the larger-company mineral exploration market in eastern Europe was valued at $21 million, or roughly 1% of the $2.1 billion larger-company market worldwide. The larger Canadian-based companies planned to spend $9 million in eastern Europe, equivalent to about 40% of the market. Canadian-based companies held the dominant share of the market in Romania.

In Romania, Gabriel Resources Limited planned to spend $6 million on grass-roots exploration for gold. In addition, based on previous exploration and other results, Gabriel planned to start construction in late 2004 of a 13-Mt/y conventional open-pit mine at Rosia Montana. The capital cost of that mine, which is expected to produce 533 000 oz of gold annually over a period of some 16 years, is estimated at US$437 million. Proven and

Figure 13

Canadian Mineral Property Portfolio in Western Europe, 1991-2002 – Countries Accounting for 90% of Canadian Holdings in 2002

Companies of All Sizes Listed on Canadian Stock Exchanges

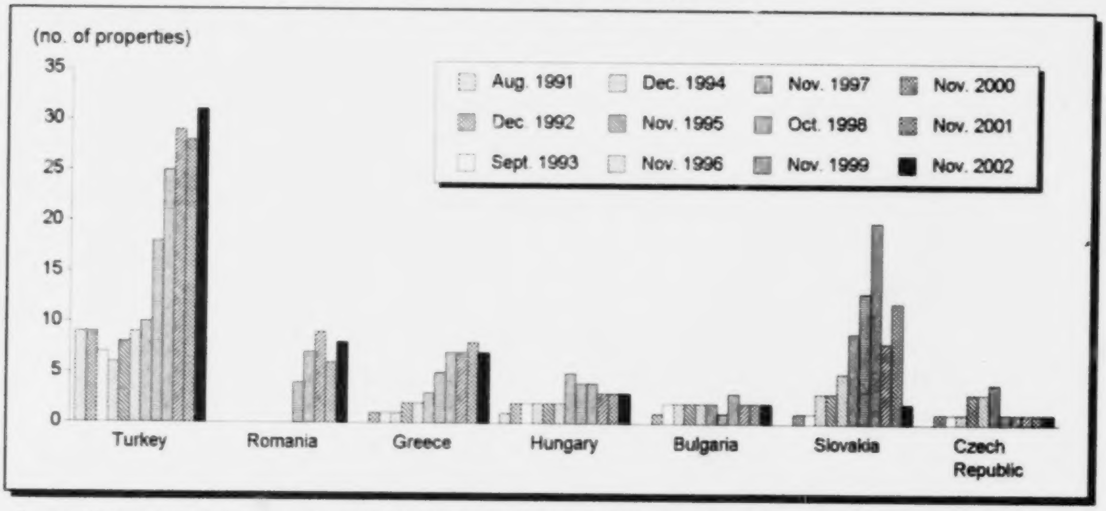


Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Figure 14

Canadian Mineral Property Portfolio in Eastern Europe, 1991-2002 – Countries with Canadian Holdings in 2002

Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

probable reserves at Rosia Montana are estimated at 218 Mt grading 1.52 g/t gold and 7.5 g/t silver. Production is expected to start in mid-2006.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in 55 mineral properties in eastern Europe. They held more than 30 in Turkey and roughly 10 in each of Romania and Greece (Figure 14).

Former Soviet Union

In 2002, the larger-company mineral exploration market in the countries of the FSU was valued at more than $80 million,[11] or roughly 4% of the $2.1 billion larger-company market worldwide. The larger Canadian-based companies planned to spend $24 million in the FSU, 60% more than in 2001.

The larger-company market for mineral exploration in the FSU apparently grew by more than $40 million in 2002 compared with 2001. This apparent increase occurred largely because Russian-based Alrosa Diamond disclosed its annual exploration budget for the first time in 2002. The exploration budget of this company, all of which was destined for Russia, was estimated at over $50 million.

Russia is the country of the FSU where the larger Canadian-based companies planned to undertake most of their exploration programs in 2002. They were expected to spend $24 million there, equivalent to 30% of the market.

High River Gold Mines Ltd. planned to spend $7 million in Russia, roughly 80% of it to increase reserves at the Zun-Holba and at the Irokinda gold mines in Siberia. Archangel Diamond Corporation planned to spend $4.8 million on advanced exploration at the Grib diamond pipe. Bema Gold Corporation planned to spend $4.4 million on exploration for gold and silver at the Julietta underground mine and at other locations in the country. Kinross planned to spend most of its $3.6 million budget for Russia at the Birkachan gold deposit. That deposit is expected to provide additional ore to the company's processing plant located at the nearby Kubaka open-pit gold-silver mine where reserves are expected to be depleted by year-end 2003.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in over 50 mineral properties in six countries of the FSU (Figure 15), about the same as in the previous year. The number of properties held in Russia stood at 25.

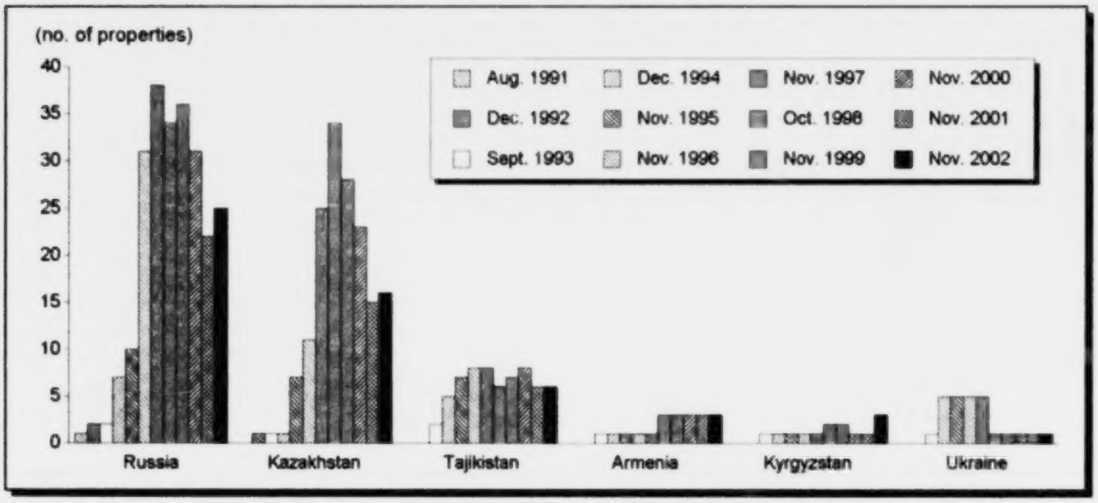
Africa and the Middle East

In 2002, the larger-company mineral exploration market in Africa and the Middle East was valued at more than

Figure 15

Canadian Mineral Property Portfolio in the Former Soviet Union, 1991-2002 – Countries with Canadian Holdings in 2002

Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

$330 million (Figure 4), or more than 15% of the $2.1 billion larger-company market worldwide. Africa accounts for almost all of the mineral exploration market in the region.

Africa

In 2002, the larger-company mineral exploration market in Africa was valued at over $325 million, or more than 15% of the $2.1 billion larger-company market worldwide. The larger Canadian-based companies planned to spend more than $50 million in Africa, equivalent to over 15% of the market on that continent.

In 2002, Barrick was expected to spend $25 million looking for gold in Tanzania. Barrick's exploration program for Tanzania was the largest one in all of Africa. Tanzania ranks sixth in the world in terms of countries where Canadian companies are the most active in mineral exploration (Figure 6).

Barrick planned to spend $14 million of its budget for Tanzania to further assess the economic potential of the Tulawaka gold deposit. At year-end 2002, the company was completing a feasibility study for an open-pit mine there. A production decision for Tulawaka was expected in mid-2003.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in over 530 mineral properties in 35 countries on the African continent, roughly the same number as at the end of the previous year. Canadian companies held interests in 80 properties in South Africa, more than 40 in each of Burkina Faso, Ghana and Tanzania, and more than 30 in each of Mali and Zimbabwe (Figure 16).

Middle East

In 2002, the larger-company mineral exploration market in the Middle East was valued at roughly $7 million. The larger Canadian-based companies planned to spend $0.2 million there, equivalent to 2% of the market in the region.

Asia-Pacific

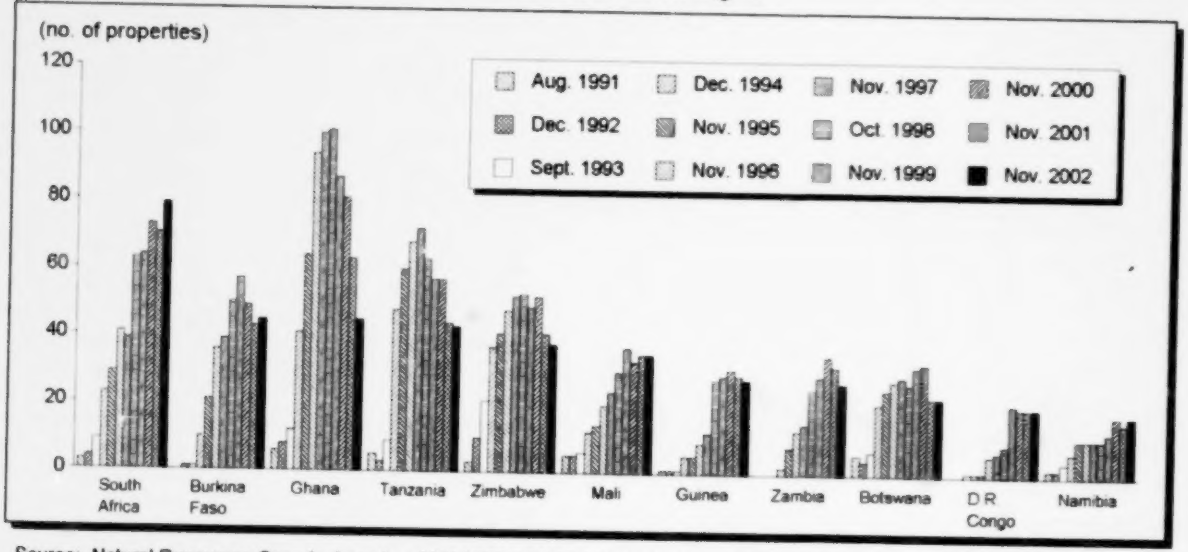
In 2002, the larger-company mineral exploration market in Asia-Pacific was valued at $490 million (Figure 4), or roughly one quarter of the $2.1 billion larger-company market worldwide. The value of exploration programs in the region in 2002 was $130 million less than in 2001.

The larger Canadian-based companies planned to spend $111 million in the Asia-Pacific region, equivalent to over

Figure 16

Canadian Mineral Property Portfolio in Africa, 1991-2002 – Countries Accounting for 75% of Holdings in 2002

Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

23% of the market. Even though their budgets for Asia-Pacific in 2002 were maintained at the same level as in 2001, their share of the market increased by about 5%.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in 350 mineral properties in Asia-Pacific (Figure 3), the same number they held at the end of the previous year.

Southeast Asia

In 2002, the larger-company mineral exploration market in Southeast Asia was valued at almost $70 million, or slightly more than 3% of the $2.1 billion larger-company market worldwide. Exploration budgets for the region were down by $65 million compared with those of the previous year. In Indonesia alone, exploration programs were expected to be reduced by more than $35 million.

The larger Canadian-based companies planned to spend $12 million in the region, equivalent to more than 16% of the market there. Canadian budgets for individual countries were relatively small and no single company planned to spend much more than $4 million in any single country.

In Indonesia, Placer Dome planned to spend $4 million on grass-roots exploration for gold. In Papua New Guinea, the company planned to spend roughly $2 million to increase reserves at the Porgera open-pit gold mine. In Myanmar, Ivanhoe Mines Ltd. planned to spend $0.8 million on grass-roots exploration for gold and copper. In Vietnam, Falconbridge planned to spend $0.9 million at the Ta Khoa nickel-copper-cobalt project, which includes the Ban Phuc nickel-copper deposit, and Tiberon Minerals Ltd. continued to assess the Nui Phoa tungsten-fluorite-copper-gold-bismuth deposit.

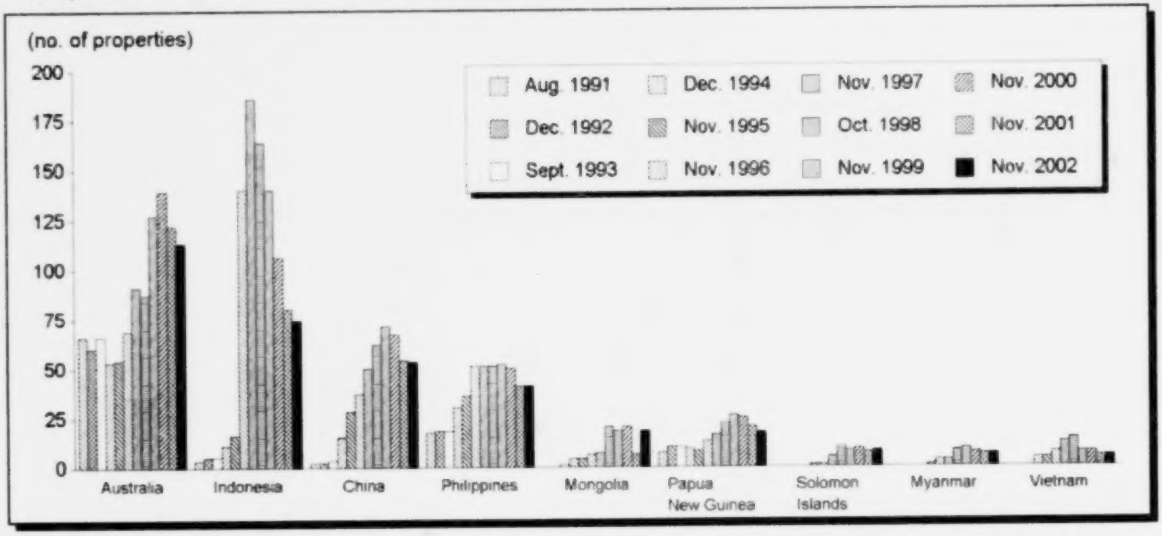
At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in almost 150 mineral properties in Southeast Asia, about the same as in the previous year. They held about 70 properties in Indonesia and more than 40 in the Philippines (Figure 17).

East Asia

In 2002, the larger-company mineral exploration market in east Asia, which includes China, Japan, Mongolia and South Korea, was valued at $38 million,[11] or almost 2% of the $2.1 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $20 million in the region, equivalent to more than 60% of the market.

Since the early 1990s, there has been considerable Canadian interest in the mineral potential of China and in the

Figure 17
Canadian Mineral Property Portfolio in Asia-Pacific, 1991-2002 – Countries Accounting for 95% of Canadian Holdings in 2002
Companies of All Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

significant growth in demand expected to occur there for many mineral commodities.

In 2002, Placer Dome, Falconbridge and Inco Limited planned exploration programs in China. Placer Dome, which reported the largest Canadian exploration budget for China, planned to spend $2 million on grass-roots exploration for gold in that country. In late 2002, companies of all sizes listed on Canadian stock exchanges held interests in over 50 mineral properties in China (Figure 17).

In Mongolia, Ivanhoe planned to spend almost $16 million on exploration for gold and base metals, about 60% of it at the Oyu Tolgoi (Turquoise Hill) deposit. Cameco Corporation planned to spend over $4 million on advanced exploration for gold in Mongolia. Cameco is also building a US$40 million open-pit gold mine at Boroo in that country. In South Korea, Ivanhoe planned to spend about $1.5 million on grass-roots exploration for gold and copper.

South Pacific

In 2002, the larger-company mineral exploration market in the South Pacific was valued at $368 million, or more than 17% of the $2.1 billion larger-company market worldwide. Although there were increases in some countries, budgets for the region were down by $72 million, or by 16% compared with those of the previous year. Activity in Australia alone was expected to decrease by over $80 million, which represents the largest reduction in activity anywhere in the world for a single country from 2001 to 2002.

The larger Canadian-based companies planned to spend $76 million in the South Pacific, equivalent to over 20% of the market in the region. Australia and New Caledonia rank fourth and ninth, respectively, in terms of countries where Canadian companies are the most active in mineral exploration (Figure 6).

In New Caledonia, Falconbridge planned to spend over $20 million for advanced exploration at the Koniambo lateritic nickel deposit. The company's budget for Koniambo in 2002 was among the largest for a single Canadian project abroad. Measured and indicated resources at Koniambo are estimated at 121 Mt grading 2.15% nickel and 0.06% cobalt. A pre-feasibility study for a 60 000-t/y ferronickel plant at Koniambo was completed in the second half of 2002 and a feasibility study was expected to begin in the third quarter of 2003.

In December 2002, Inco announced that it was undertaking a comprehensive review of its Goro project, also in New Caledonia, for which earlier estimates of capital costs were expected to escalate by as much as 45%. The company planned to complete that review in mid-2003. Inco had previously announced that it planned to build a US$1.45 billion open-pit mine and processing plant that would use hydro-metallurgical and solvent-extraction processes. Goro would have a capacity of 55 000 t/y of nickel and 4500 t/y of cobalt. As of the end of 2002, Inco had spent, in total, roughly US$350 million assessing the viability of the Goro project.

During 2002, Placer Dome acquired Australian-based AurionGold Limited.[12] As a result, Placer Dome became not only the second largest gold producer in Australia, but its exploration budget for the country grew to more than $30 million. The combined budgets of Placer Dome and AurionGold represent one of the largest exploration programs for a single country. As a result of its acquisition of AurionGold, Placer Dome added three new gold mining operations to its assets in Australia: Henty, Kanowna Belle and Kalgoorlie West. The latter includes the Kundana and Paddington mills, the Kundana mine, 51% of the East Kundana mine, and 49% of the Mungari West mine. Also as a result of its acquisition of AurionGold, Placer Dome increased its share of the Granny Smith gold mine to 100%.

Also in Australia, Barrick was expected to spend roughly $5.5 million on exploration in the vicinity of the Plutonic gold mine and at other locations in the country.

At the end of 2002, companies of all sizes listed on Canadian stock exchanges held interests in almost 130 properties in the South Pacific, of which roughly 90% were located in Australia (Figure 17).

South Asia

In 2002, the larger-company mineral exploration market in South Asia, which includes India, Pakistan and Sri Lanka, was valued at about $16 million, or less than 1% of the $2.1 billion larger-company market worldwide. The larger Canadian-based companies reported no exploration programs for that region of the world in 2002.

SUMMARY AND OUTLOOK

In 2002, the larger Canadian-based companies planned to conduct mineral exploration programs valued at almost $675 million in Canada and elsewhere around the world. As a result, Canadians were expected to undertake 32% of the $2.1 billion in exploration programs planned that year by all of the world's larger companies. The share of the global mineral exploration market controlled by Canadian companies is the largest, by far; it is about twice as large as the share controlled by companies based in Africa or in Australia.

Almost 16% of the world's larger-company mineral exploration activities was expected to occur in Canada in 2002, somewhat more than in 2001. Canada became, during 2002, the country where the world's companies are the most active in mineral exploration. During the 10-year period from 1992 to 2001, the world's mining companies had spent more on mineral exploration in Australia than in any other country.

During 2002, and for the third year in a row, Canadian exploration programs for Canada were larger than those they planned for all of Latin America. Canadian companies were expected to carry out the largest share of exploration programs, not only in this country, but also in the United States, eastern Europe, and East Asia. They planned to undertake almost as much exploration in South America as all of the companies based in that region of the world combined. Although Canadian companies have diversified their portfolio of mining interests to well over 100 countries, Canada remains the country where they continue to be, by far, the most active in mineral exploration.

Mineral commodity prices have remained relatively low. This affects the amount of profits that producers can reinvest in mineral exploration. Companies with exploration funds are focussing their efforts on their most promising assets. For many of the smaller companies, financing exploration projects continues to be difficult and, as a result, many of them are inactive.

The larger-company exploration market is becoming increasingly concentrated. The number of companies spending the equivalent of US$3 million per year on exploration (C$4.7 million in 2002) has decreased significantly since the late 1990s when financing was readily available. In the case of Canadian companies, the number of larger companies has fallen from an all-time high of 141 in 1997 to fewer than 40 in 2002.

Transnational mergers and acquisitions have become a frequent occurrence in the mining industry. As a result, the industry is becoming increasingly more globalized in its operations. In Canada, the share of the mineral exploration market controlled by foreign companies has grown from 20% in 1992 to slightly more than 30% in 2002.

Although Canadian companies tend, on average, to have smaller exploration budgets than their competitors, they are considerably more numerous than companies based elsewhere. As a result, Canadians are likely to continue, for the near future at least, to dominate mineral exploration worldwide.

REFERENCES

[1] All currencies in this review are expressed in Canadian dollars unless indicated otherwise.

[2] Most of the statistical data on the larger-company mineral exploration market worldwide are based on *Corporate Exploration Strategies: A Worldwide Analysis*, published annually by Metals Economics Group, Halifax, Nova Scotia (tel. [902] 429-2880). The information on specific projects is based on company reports.

[3] Keith Brewer and André Lemieux, *Canada's Global Position in Mining - Canadian Financing of the International Mining Industry*, Metals Finance 4th International Conference, Toronto, May 7-9, 1997, Natural Resources Canada, Ottawa, 53 pp. (tel. [613] 995-4577).

[4] For more information on various aspects of the relationship between exploration budgets and exploration expenditures for the larger Canadian-based companies, see André Lemieux, "Canada's Global Mining Presence," in the 1998 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 7.1 and 7.2 (www.nrcan.gc.ca/mms/cmy/content/1998/08.pdf).

See also André Lemieux, "Canada's Global Mining Presence," in the 1999 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 7.1 and 7.3 (www.nrcan.gc.ca/mms/cmy/content/08.pdf).

[5] Most of the data for 1991 through 1997 on the mineral property portfolio of companies of all sizes listed on Canadian stock exchanges are derived from MIN-MET CANADA; for 1998 through 2002, they are derived from InfoMine db. These databases are products of Robertson Info-Data Inc. of Vancouver, British Columbia (tel. [604] 683-2037).

[6] For trends in mineral deposit appraisal activity in Canada over the interval 1982-97, and for a list of projects at the deposit appraisal stage in the late 1990s, see André Lemieux, "Canada's Global Mining Presence," in the 1996 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 8.9 and 8.11-8.22 (www.nrcan.gc.ca/mms/cmy/content/1996/08.pdf).

[7] For a list of mines, smelters, refineries and other advanced mineral development projects in which companies based in Canada had an interest in mid-2001, see André Lemieux, "Canada's Global Mining Presence," in the 2000 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 7.16-7.19 (www.nrcan.gc.ca/mms/cmy/content/08.pdf).

[8] "Project Investment Survey 2003," *Engineering & Mining Journal*, January 2003, pp. 28-34.

[9] For a discussion of the global market for mining goods and services and the role played by Canadian companies, see André Lemieux, *Canadian Suppliers of Mining Goods and Services: Links Between Canadian Mining Companies and Selected Sectors of the Canadian Economy*, Natural Resources Canada, Ottawa, September 2000, 84 pp. (www.nrcan.gc.ca/mms/pdf/minegs_e.pdf).

[10] For the geographic distribution of mineral properties in which Canadian companies have an interest in the United States and in Mexico, see André Lemieux, "Canada's Global Mining Presence," in the 2000 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 7.5 and 7.7 (www.nrcan.gc.ca/mms/cmy/content/08.pdf).

[11] The size of the mineral exploration market in certain regions of the world is underestimated because there are few data available on the extent of exploration programs undertaken by some private enterprises or state agencies.

[12] Vancouver-based Placer Dome Inc. acquired Australian-based AurionGold Limited in October, 2002. The exploration budget of Placer Dome discussed in this review refers to the combined budgets of the two merged companies.

Notes: (1) Information in this review was current as at August 2003. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002CMY_e.htm.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Outlook for Canadian Mine Production, Mine Life and Ore Reserves

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INTRODUCTION

The purpose of this chapter is to provide the reader with an understanding of the outlook for mining in each of Canada's 13 provinces and territories over the medium term to 2026.

The mineral commodities covered are metals, the industrial minerals, construction materials and coal. The emphasis is on metal mining. Based on the best information the author was able to obtain in 2002, estimates have been made of the expected lives of Canada's metal mines, either individually or in groups, such as all mines at Sudbury, Ontario, or all the gold mines in Quebec.

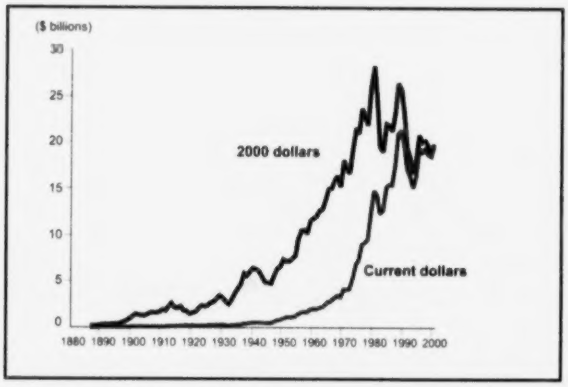
When looking at predicted mine lives, one should keep in mind that the prices of the metals produced in Canada, notably the prices of copper, lead and zinc, were exceptionally low in 2002 and continue to be low. Such low prices might result in the unexpected closure of mines, either temporarily or, in the case of mines already near the end of their lives such as the Con mine in the Northwest Territories and the Lupin mine in Nunavut, both of which closed in 2003 after this chapter was written, closure could be permanent.

CANADA'S MINERAL PRODUCTION HISTORY

Canada's non-petroleum mineral production has increased over the more than 115 years for which production statistics are available. Figure 1 shows the value of Canada's non-petroleum mineral output from 1886 to 2000. In inflation-adjusted year 2000 dollars, the production peak in the 1970s, and the decline in production value since then, probably reflect exceptionally high metal prices in the 1970s followed by generally declining metal prices rather than lower physical production of minerals.

In Figure 2, the graph at the top depicts Canada's annual metal production from 1886 to 2000 converted to 2001 dollars to compensate for inflation. The graph at the bottom depicts Canada's annual metal production tonnages all valued at metal prices of mid-2002. The graph demonstrates that Canada's aggregate metal production has not declined significantly over the past 30 years.

Figure 1
Value of Canada's Non-Petroleum Mineral Production, 1886-2000

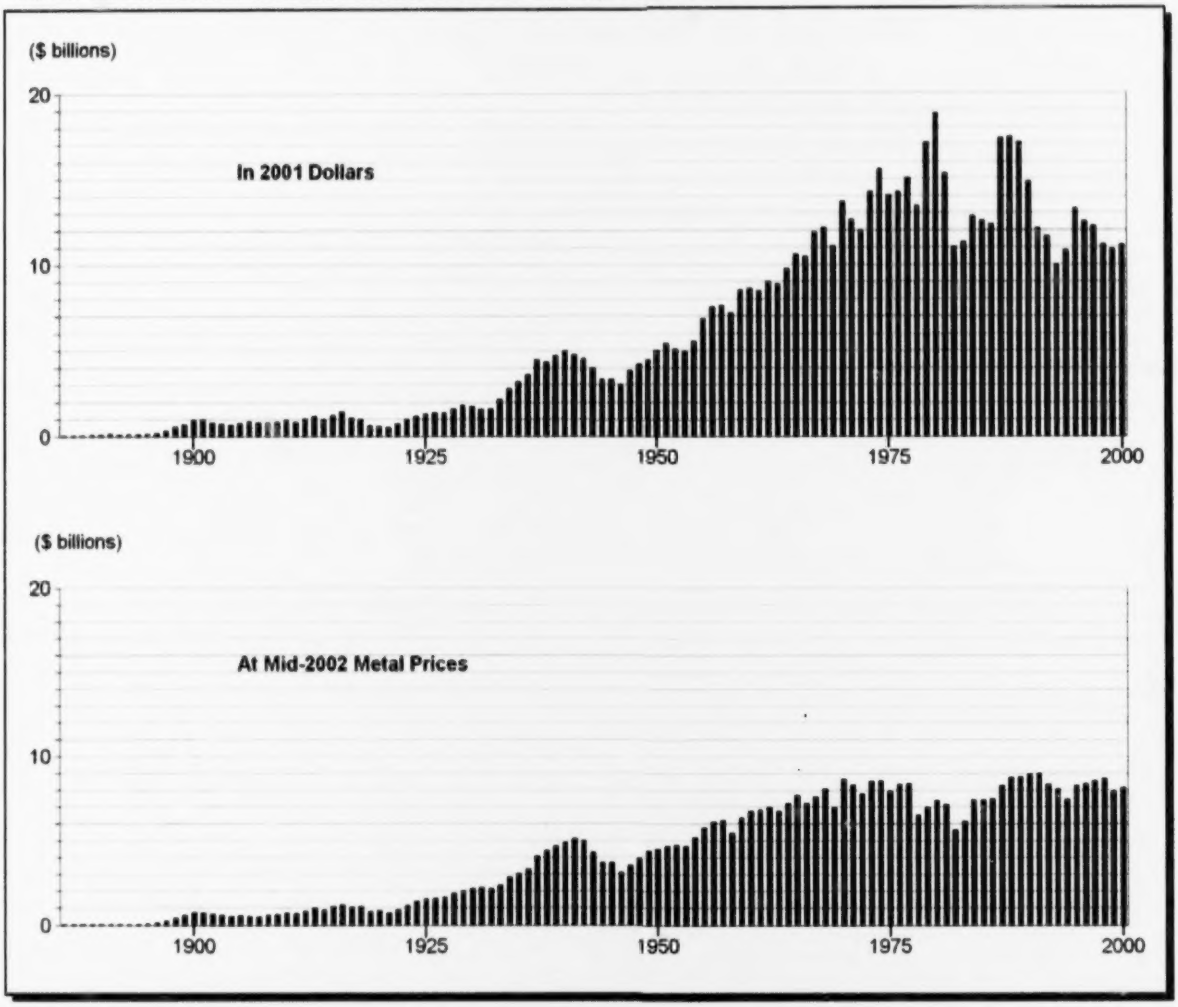


Source: Natural Resources Canada.

CANADA'S POSITION IN MINERAL EXPLORATION

For 22 years, Canada has been one of the world's top two mineral exploration targets (Figure 3). Since 1992, Canada has been second after Australia as a recipient of exploration expenditures. With Australia's mineral production in 1998 being 27% higher than that of Canada, it is not surprising that Australia has been ahead of Canada in terms of mineral exploration expenditures. However, indications are that exploration expenditures in Canada exceeded those in Australia again in 2002, likely as a result of the Canadian exploration tax credit for flow-through share investors.

Figure 2
Value of Canadian Metallic Mineral Production, 1886-2000



Source: Natural Resources Canada.

It may be that the exploration efforts in China and in Russia, both of them countries that are more important mineral producers than Canada, exceed those in Canada. However, comprehensive exploration expenditure statistics are not available for either of those countries.

Provided that the necessary exploration expenditures are made, a substantial number of metal orebodies should be discovered in Canada and developed for production over the next 25 years. However, there is no certainty that discoveries will be made in all provinces and territories.

MINERAL PRODUCTION BY PROVINCE AND TERRITORY, NOW AND IN THE FUTURE

Figures 4 to 16 depict, for each province and territory, expected future mineral production from current mines and from mines being developed, but not for mines that may be developed from deposits for which a firm production decision had not been made by the end of 2002. There will be additional discoveries and additional new mines in most provinces and territories. These are not shown in Figures 4 to 16.

Figure 3
Top Three Country Destinations of Mineral Exploration Capital from World-Wide Sources, 1980-2001

	RANK		
	1	2	3
2001	Australia	**Canada**	United States
2000	Australia	**Canada**	United States
1999	Australia	**Canada**	United States
1998	Australia	**Canada**	United States
1997	Australia	**Canada**	United States
1996	Australia	**Canada**	United States
1995	Australia	**Canada**	United States
1994	Australia	**Canada**	United States
1993	Australia	**Canada**	United States
1992	Australia	**Canada**	United States
1991	**Canada**	Australia	United States
1990	**Canada**	Australia	United States
1989	**Canada**	Australia	United States
1988	**Canada**	Australia	United States
1987	**Canada**	Australia	United States
1986	**Canada**	Australia	United States
1985	**Canada**	Australia	United States
1984	**Canada**	Australia	United States
1983	**Canada**	Australia	United States
1982	**Canada**	Australia	United States
1981	**Canada**	Australia	United States
1980	Australia	**Canada**	United States

Source: Natural Resources Canada.

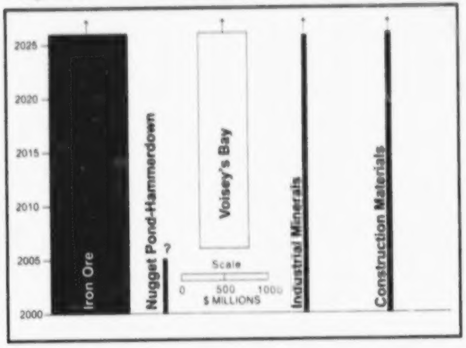
For each metal mine or group of metal mines, the width of each bar is based on expected production values at March 2001 metal prices. For industrial minerals, construction materials and coal, bar widths are based on provincial/territorial production values in 1999.

The bars for some mines have both black and white portions. The black portion represents production based on 2002 ore reserves. The white portion represents either additional known resources expected to be upgraded to reserves in the future or, in a few cases (Raglan, Niobec, Kidd Creek, Hudson Bay Mining and Smelting Co., Limited [HBMS], Eskay Creek and Highland Valley Copper), the white portion of the bars reflects either company statements concerning future potential ore or the author's expectations that levels of ore reserves that have been maintained over the years will continue to be maintained.

Newfoundland and Labrador

In the province of Newfoundland and Labrador, production from the Voisey's Bay deposit is expected to commence in 2006 and will result in a substantial increase in the value of the province's mineral production. There is a good possibility that production of iron ore will also increase. Production capacity for iron ore was recently increased by 25% at one operation and by a smaller percentage at the other.

Figure 4
Newfoundland and Labrador
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Nova Scotia

Metals are not produced in Nova Scotia.

Prince Edward Island

Metals are not produced in Prince Edward Island.

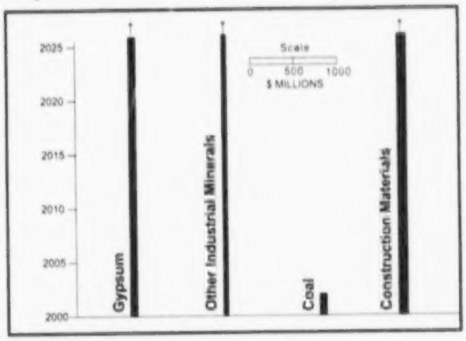
New Brunswick

In New Brunswick, ore reserves at the Brunswick No. 12 mine will be depleted by 2010 with production expected to decline after 2007. The mine might close as early as 2008. The Noranda Inc. Halfmile Lake deposit, not yet developed for production, will not be viable at foreseeable zinc prices, so it is not portrayed in Figure 7. Several tens of millions of tonnes of mineralized material are known to exist at the Caribou mine. There have been several attempts to mine this deposit, but they have not succeeded because of extremely poor metallurgical recoveries. The current owner of the mine has stated that metallurgical recoveries can be improved but that higher zinc prices will be required. Such prices would have to be much higher than 2002 zinc prices. The carrying value of the mine has recently been written down from $53.4 million to zero. It is highly unlikely that zinc prices higher than those that have prevailed in recent years will be available in the future except possibly for short periods. Therefore, any future production from the Caribou mine is likely to be sporadic at best.

Quebec

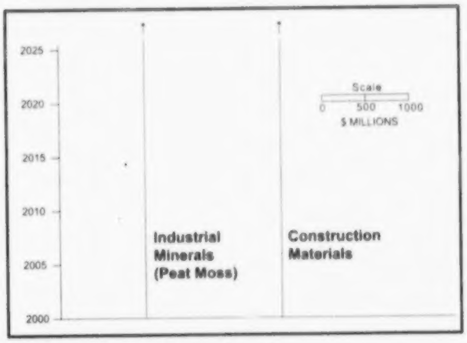
In Quebec, production of iron ore, nickel, ilmenite, niobium, industrial minerals other than asbestos, and construction materials is likely to continue at current or higher levels for at least the next 25 years.

Figure 5
Nova Scotia
Expected Mineral Production, 2000-2026



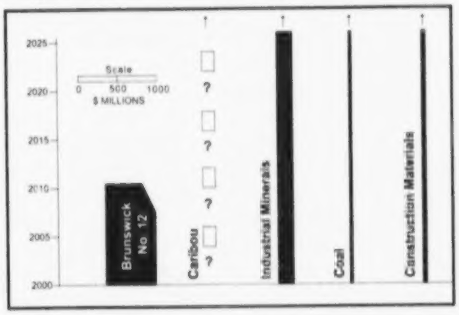
Source: Natural Resources Canada.

Figure 6
Prince Edward Island
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Figure 7
New Brunswick
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

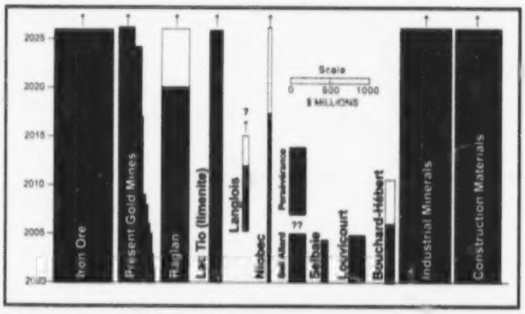
The Louvicourt and Selbaie mines, and possibly the Bouchard-Hébert mine, are expected to close in about 2004 or 2005.

The Bell Allard mine at Matagami will run out of ore at the end of 2004. Owing to the low zinc price and to the financial situation of Noranda Inc., production from the Perseverence deposit will be delayed, perhaps until about 2006. Noranda is of the opinion that there is still considerable potential for additional discoveries in the Matagami area.

Current reserves and measured and indicated resources at the Raglan operation are adequate to support production there until 2020. New deposits continue to be discovered; therefore, production is likely to continue for longer than 25 years.

The Langlois mine will eventually re-open. Once it does, it is expected to produce for seven years. If metal prices are adequate it might produce for longer. Production at Langlois is arbitrarily shown in Figure 8 as beginning in 2005.

Figure 8
Quebec
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Ontario

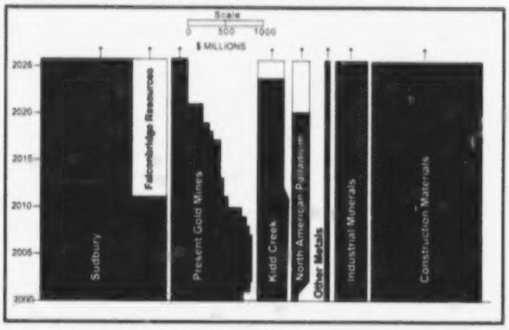
In Ontario, Inco Limited's current reserves at Sudbury are adequate to support production there well beyond 2026. Although Falconbridge Limited's current proven and probable reserves are adequate for only about nine years, the Onaping deep deposit, discovered in 1996, and the Nickel Rim South deposit, discovered in 2001, together should support Falconbridge's current production level at Sudbury for approximately another 18 years. Although both deposits are exceptionally high grade (for Sudbury), they are not yet included in proven and probable reserves.

For the Kidd Creek mine, the Falconbridge 2001 Annual Report states that current reserves and resources will support production until 2024 and that the orebody is open below the currently planned bottom mining depth of 10 000 feet, so production seems likely to continue beyond 2024.

Current proven and probable reserves and resources, and measured and indicated resources, of North American Palladium Ltd. are adequate to support production for 29 years, although low palladium prices may have a negative effect on the life of the mine.

As a production decision has not yet been made, Figure 9 does not include Falconbridge's proposed Montcalm nickel mine, which should be capable of producing some $160 million of nickel annually over a seven-year period.

Figure 9
Ontario
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Manitoba

In Manitoba, current ore reserves and resources for the Thompson Nickel Belt can support current production levels there until 2022 or 2023. Both the Thompson and Birchtree orebodies are open at depth (although the depth potential at the Thompson mine appears limited) and there are other known ore deposits in the area that are not yet included in ore reserves, so it seems likely that Thompson Nickel Belt production will continue beyond 2026.

Hudson Bay Mining and Smelting Co., Limited (HBMS) has current ore reserves and resources that will be sufficient to produce until 2016. Production seems likely to continue well beyond 2016 for the following reasons:

- The large new 777 orebody is open at depth and laterally.
- HBMS has operated a total of 29 mines in the Flin Flon-Snow Lake area to date.
- The company has discovered three more orebodies per decade since 1940, including three in the 1990s.

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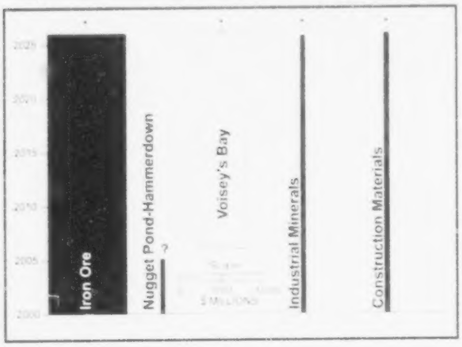

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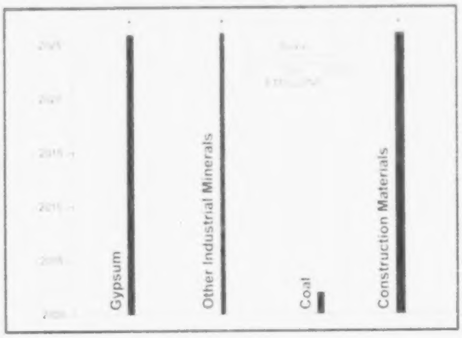

Source: Natural Resources Canada

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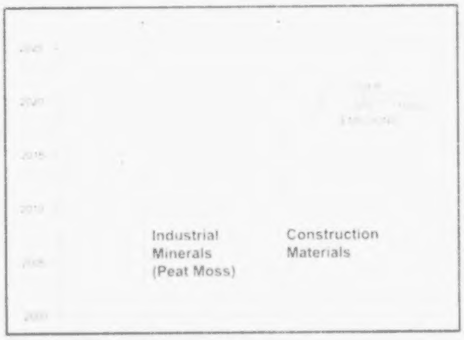

Source: Natural Resources Canada

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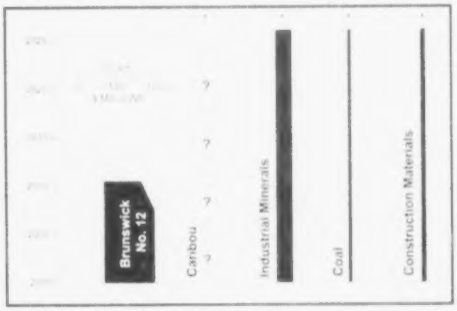

Source: Natural Resources Canada

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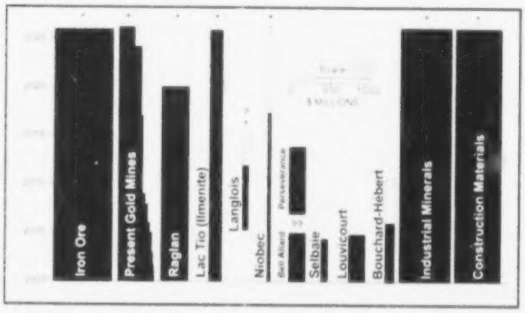

Source: Natural Resources Canada.

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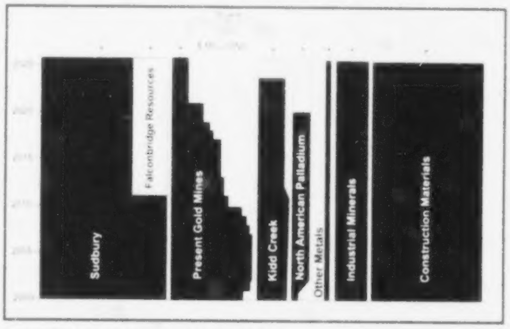

Source: Natural Resources Canada.

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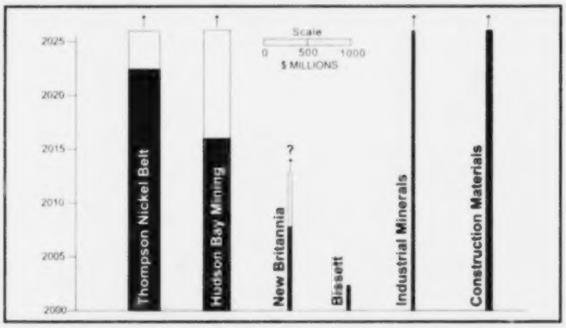
- Anglo American plc's Spectrem airborne geophysical system has been flown over the area and yielded two new orebodies and many new anomalies that have not yet been drilled.
- It would be surprising if additional orebodies are not discovered.

Figure 10
Manitoba
Expected Mineral Production, 2000-2026



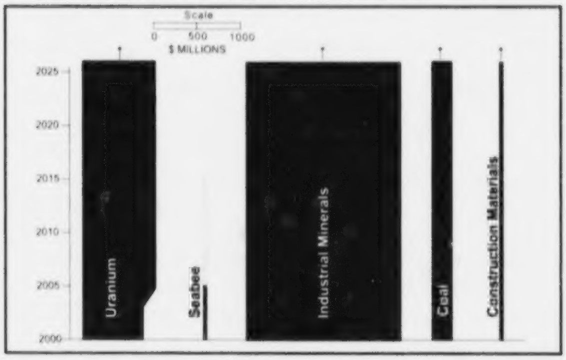
Source: Natural Resources Canada.

Saskatchewan

In Saskatchewan, uranium is the principal metal produced. Current ore reserves and resources are adequate to support current or higher production beyond 2026.

HBMS's Konuto Lake mine, located in Saskatchewan, and the Saskatchewan portion of the Callinan mine have been included in the Manitoba graph (Figure 10) because data are not available that permit the separation of those mines from the company's total production and reserves information.

Figure 11
Saskatchewan
Expected Mineral Production, 2000-2026

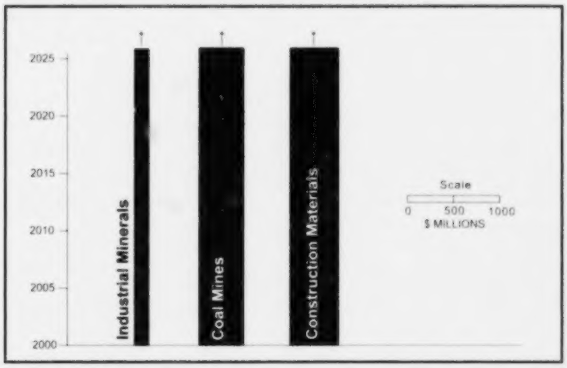


Source: Natural Resources Canada.

Alberta

Metals are not produced in Alberta.

Figure 12
Alberta
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

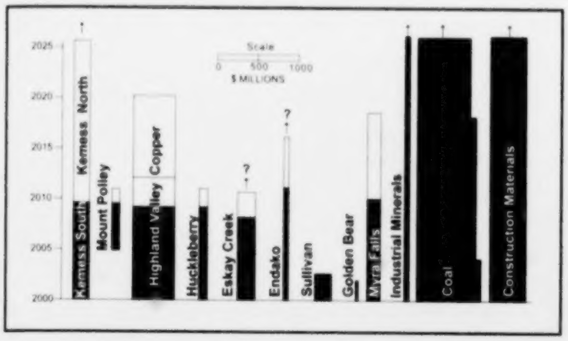
British Columbia

In British Columbia, the Kemess, Mount Polley, Highland Valley Copper, Huckleberry and Endako mines, which yield 70% of the metal production value of this province, are all low-grade porphyry-type deposits. Because many much-higher-grade and mostly much larger porphyry-type deposits in South America and elsewhere have commenced or increased production in recent years, copper and molybdenum prices have declined to the point where Canadian porphyry-type deposits have difficulty competing. Therefore, there is little interest in exploring for porphyry-type deposits in British Columbia at present. Non-porphyry deposits will have to be discovered soon if the province is to remain a significant producer of metals. This will require increased mineral exploration expenditures.

In the preparation of Figure 13, the assumption has been made that when the Kemess South orebody is mined out in about 2010, ore will come from the Kemess North deposit.

At the Highland Valley Copper mine, current ore reserves should last until 2009. Two unmined sections of the pit could be mined if market conditions for copper are appropriate. The smaller of these would extend production for three years. The larger of these would add an additional nine years to the life of the mine but would require an investment of $250 million, an investment that will depend on a favourable copper price outlook.

Figure 13
British Columbia
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Yukon

Placer gold mining is the Yukon's only remaining metal mining industry. As there has been placer mining in the Yukon continuously for 118 years, in the preparation of Figure 14 the assumption has been made that placer mining will continue for at least another 24 years, despite the new requirements.

Northwest Territories

In the preparation of Figure 15, expected production from the Ekati, Diavik and Snap Lake diamond mining operations has been estimated (Snap Lake is not yet in production but production is definitely planned), including potential production from additional deposits at Ekati that are not in the current mining plan.

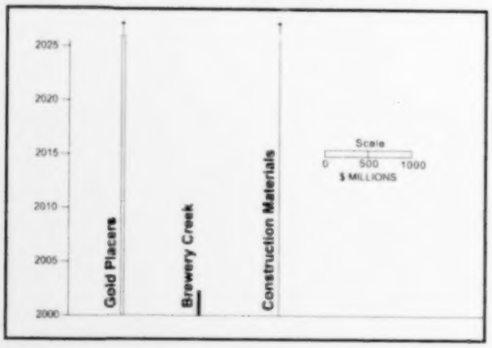
Miramar Mining Corporation plans to operate the Con mine until late 2003, but will continue to operate the Giant mine and the Con mill until the end of 2004 and hopes that production will continue beyond that. Substantial unmined resources remain in the Con mine but, because of low gold prices in 2001 and 2002, it does not appear that the required development has been done to permit mining of these resources now that the gold price has improved.

Nunavut

In Nunavut, the Lupin mine closed in August 2003, following the closures of Nanisivik and Polaris in 2002, and metal is no longer mined in the territory.

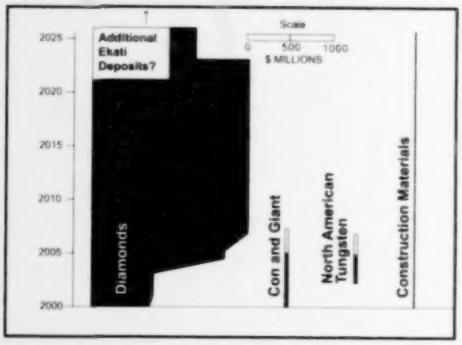
Feasibility studies are in progress for the Hope Bay and Meadowbank gold projects, where exploration continues. These two projects are not shown in Figure 16 because production decisions have not yet been made.

Figure 14
Yukon
Expected Mineral Production, 2000-2026



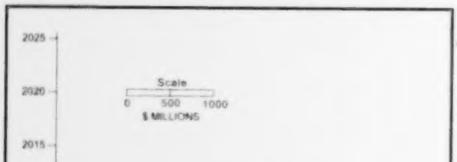
Source: Natural Resources Canada.

Figure 15
Northwest Territories
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Figure 16
Nunavut
Expected Mineral Production, 2000-2026



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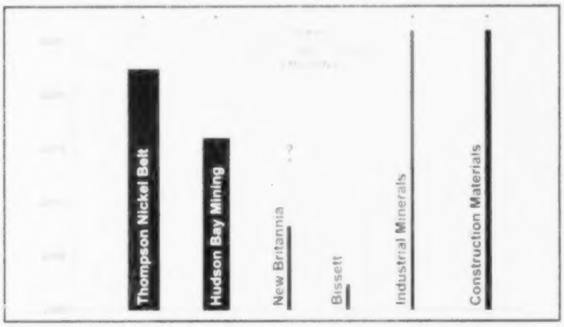

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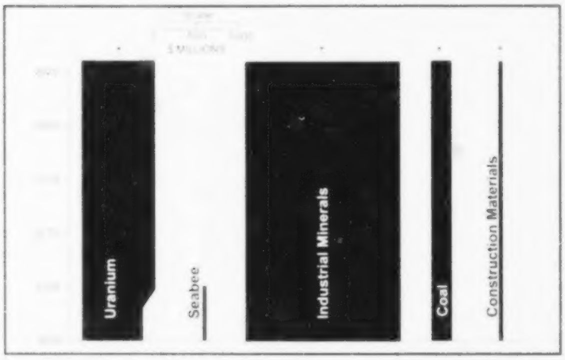
Saskatchewan

In Saskatchewan, uranium is the principal metal produced. Current ore reserves and resources are adequate to support current or higher production beyond 2026.

HBMS's Konuto Lake mine, located in Saskatchewan, and the Saskatchewan portion of the Callinan mine have been included in the Manitoba graph (Figure 10) because data are not available that permit the separation of those mines from the company's total production and reserves information.

Figure 11
Saskatchewan
Expected Mineral Production, 2000-2026

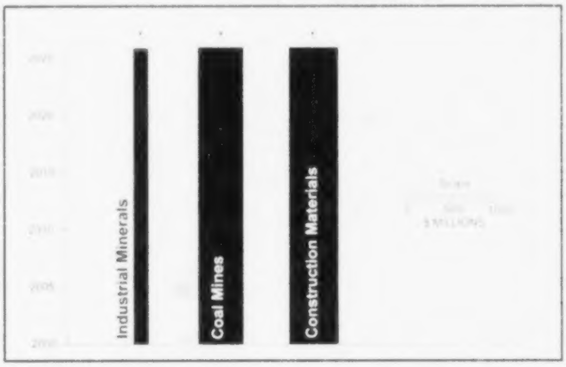


Source: Natural Resources Canada.

Alberta

Metals are not produced in Alberta.

Figure 12
Alberta
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

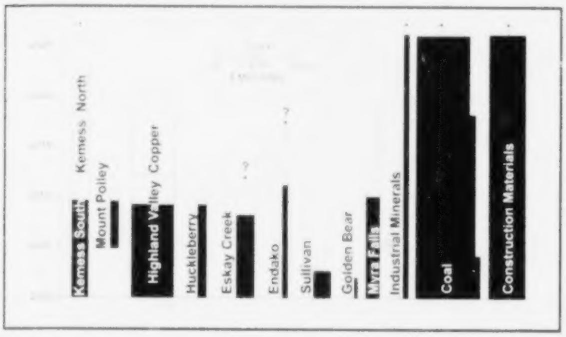
British Columbia

In British Columbia, the Kemess, Mount Polley, Highland Valley Copper, Huckleberry and Endako mines, which yield 70% of the metal production value of this province, are all low-grade porphyry-type deposits. Because many much-higher-grade and mostly much larger porphyry-type deposits in South America and elsewhere have commenced or increased production in recent years, copper and molybdenum prices have declined to the point where Canadian porphyry-type deposits have difficulty competing. Therefore, there is little interest in exploring for porphyry-type deposits in British Columbia at present. Non-porphyry deposits will have to be discovered soon if the province is to remain a significant producer of metals. This will require increased mineral exploration expenditures.

In the preparation of Figure 13, the assumption has been made that when the Kemess South orebody is mined out in about 2010, ore will come from the Kemess North deposit.

At the Highland Valley Copper mine, current ore reserves should last until 2009. Two unmined sections of the pit could be mined if market conditions for copper are appropriate. The smaller of these would extend production for three years. The larger of these would add an additional nine years to the life of the mine but would require an investment of $250 million, an investment that will depend on a favourable copper price outlook.

Figure 13
British Columbia
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Yukon

Placer gold mining is the Yukon's only remaining metal mining industry. As there has been placer mining in the Yukon continuously for 118 years, in the preparation of Figure 14 the assumption has been made that placer mining will continue for at least another 24 years, despite the new requirements.

Northwest Territories

In the preparation of Figure 15, expected production from the Ekati, Diavik and Snap Lake diamond mining operations has been estimated (Snap Lake is not yet in production but production is definitely planned), including potential production from additional deposits at Ekati that are not in the current mining plan.

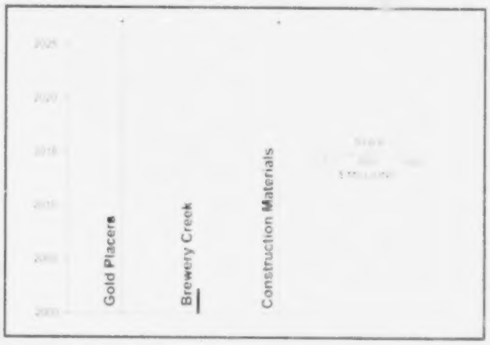
Miramar Mining Corporation plans to operate the Con mine until late 2003, but will continue to operate the Giant mine and the Con mill until the end of 2004 and hopes that production will continue beyond that. Substantial unmined resources remain in the Con mine but, because of low gold prices in 2001 and 2002, it does not appear that the required development has been done to permit mining of these resources now that the gold price has improved.

Nunavut

In Nunavut, the Lupin mine closed in August 2003, following the closures of Nanisivik and Polaris in 2002, and metal is no longer mined in the territory.

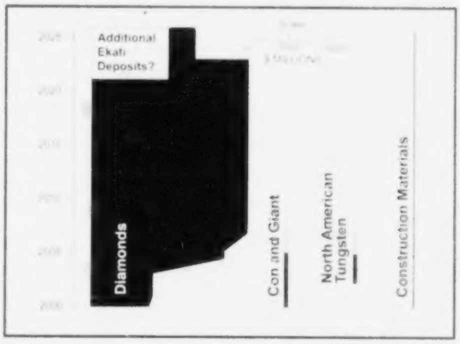
Feasibility studies are in progress for the Hope Bay and Meadowbank gold projects, where exploration continues. These two projects are not shown in Figure 16 because production decisions have not yet been made.

Figure 14
Yukon
Expected Mineral Production, 2000-2026



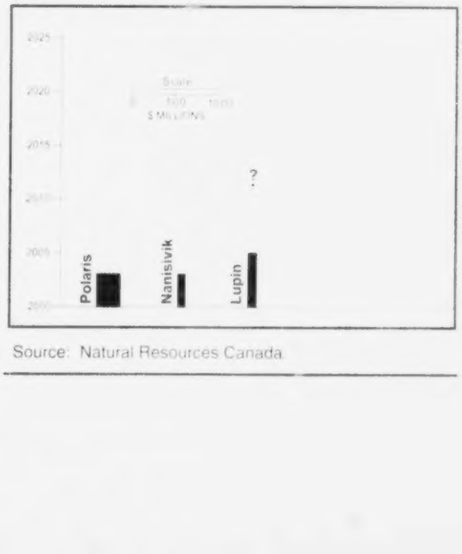
Source: Natural Resources Canada.

Figure 15
Northwest Territories
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

Figure 16
Nunavut
Expected Mineral Production, 2000-2026



Source: Natural Resources Canada.

HISTORICAL CANADIAN PRODUCTION AND RESERVES FOR VARIOUS MINERAL COMMODITIES

Nickel

Canada's nickel reserves have generally declined since 1981 because, at more than 40 times annual production, they were too expensive to maintain. Production from a mine at Voisey's Bay and recently increased production from the Raglan Nickel Belt should increase Canada's nickel production to the record levels of the early 1970s. Such production levels will be sustainable for at least the next 25 years.

Copper

Canada's copper reserves and copper production are both declining. This is because British Columbia's porphyry copper orebodies are being depleted, as are the volcanogenic copper-bearing orebodies being mined in Quebec and in New Brunswick. Copper that is expected to be produced from the Voisey's Bay and Kidd Creek mines and from mines at Sudbury and in the Flin Flon area should maintain Canada's copper production at more than half the current level for more than 25 years. New copper discoveries and new mines will be needed to maintain current copper ore reserves and production levels.

Zinc

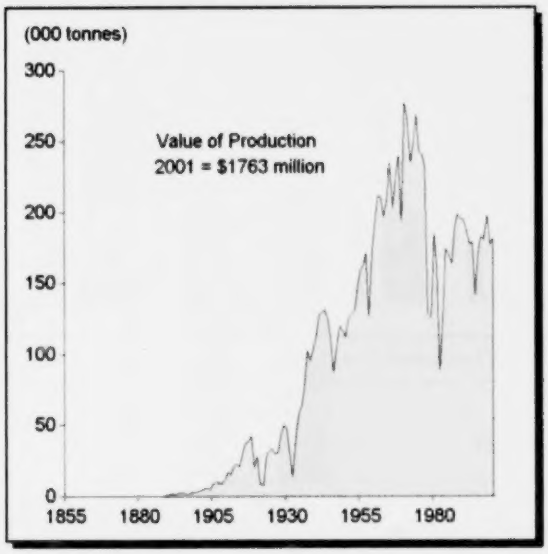
Canada's zinc reserves have been declining since the early 1980s when ore reserves began to decline at some of Canada's largest zinc mines where ore reserves could no longer be maintained once the ore limits had been defined. Without new zinc discoveries and the development of new zinc mines, Canada's zinc reserves and zinc production will continue to decline dramatically.

For the next 25 or more years, the Kidd Creek mine, together with the mines of HBMS, can be expected to yield some 200 000 t of zinc annually, about 20% of Canada's current zinc production. New discoveries will be needed to produce much more than this.

Lead

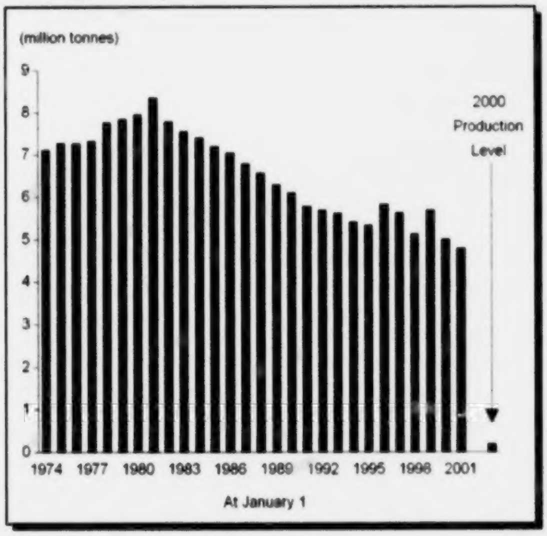
Canada's reserves of lead in ore and its lead production continue to decline. The Brunswick No. 12 mine will be mined out in another three to five years. When that mine closes, Canada's lead reserves and lead production will both be zero unless new discoveries are made. As the value of Canada's lead production was only $108 million in 2000, cessation of lead production will not have much of an impact on the total value of Canada's mineral output.

Figure 17
Nickel Production, 1889-2000



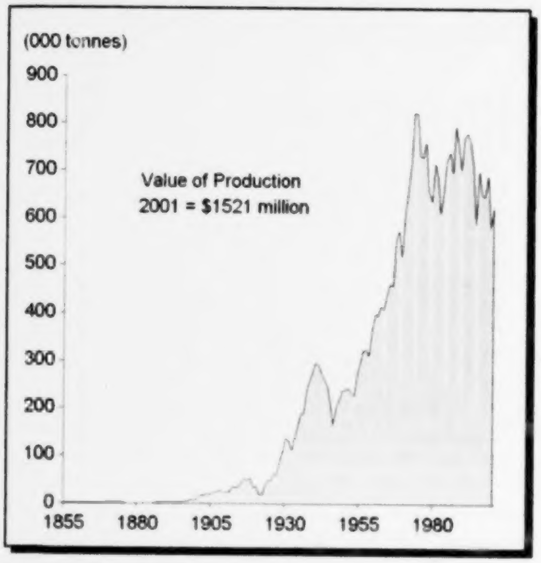
Source: Natural Resources Canada.

Figure 18
Nickel Contained in Mineable Ore, 1974-2001



Source: Natural Resources Canada.

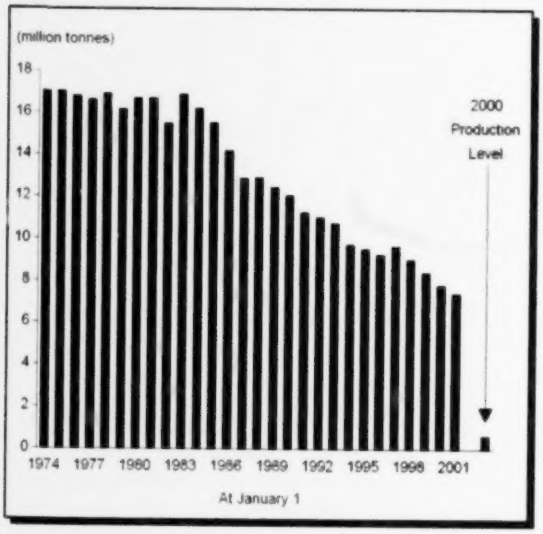
Figure 19
Copper Production, 1848-2000



Value of Production
2001 = $1521 million

Source: Natural Resources Canada.

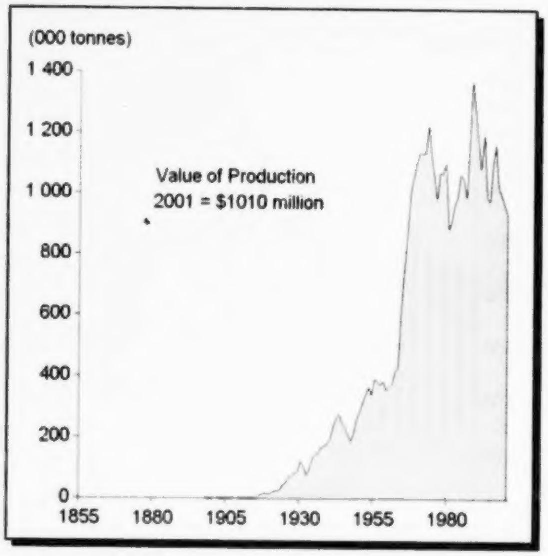
Figure 20
Copper Contained in Mineable Ore, 1974-2001



2000 Production Level

Source: Natural Resources Canada.

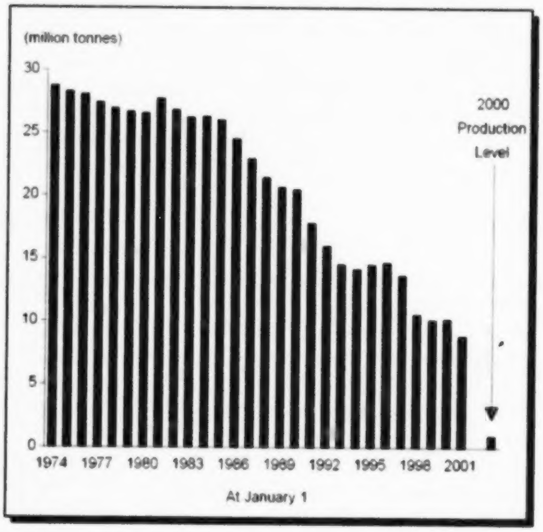
Figure 21
Zinc Production, 1898-2000



Value of Production
2001 = $1010 million

Source: Natural Resources Canada.

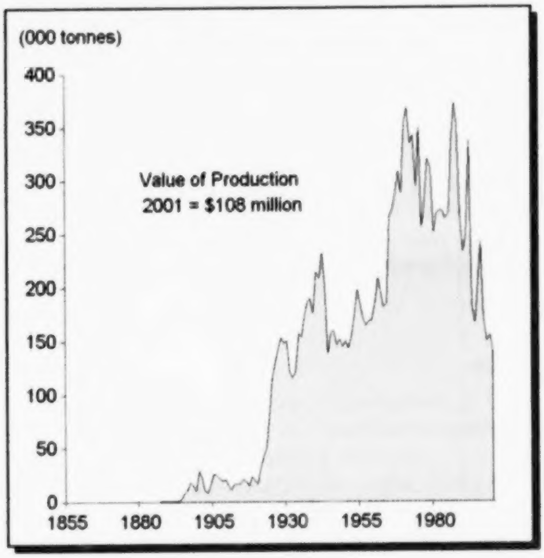
Figure 22
Zinc Contained in Mineable Ore, 1974-2001



2000 Production Level

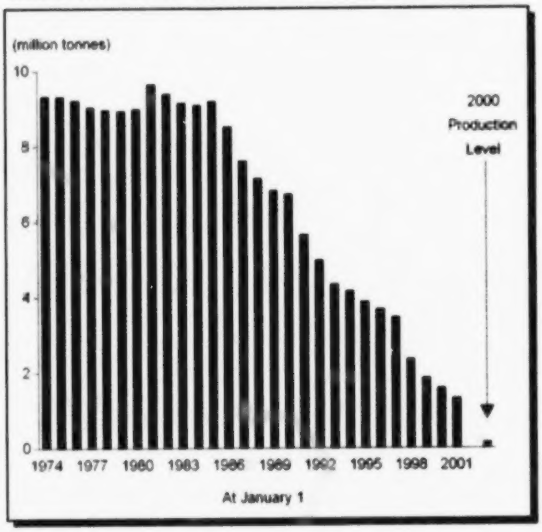
Source: Natural Resources Canada.

Figure 23
Lead Production, 1887-2000



Source: Natural Resources Canada.

Figure 24
Lead Contained in Mineable Ore, 1974-2001



Source: Natural Resources Canada.

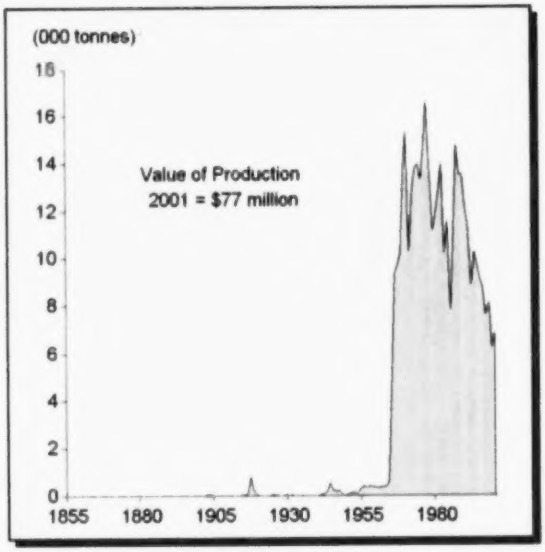
Molybdenum

The Endako, Highland Valley Copper and Huckleberry mines are Canada's only remaining molybdenum producers. All three mines have limited life expectancies. The life of the Endako mine could be extended provided molybdenum prices were adequate. As the value of Canada's molybdenum production was only $77 million in 2000, as is the case with lead, cessation of molybdenum production will not have much of an impact on the value of Canada's mineral output.

Silver

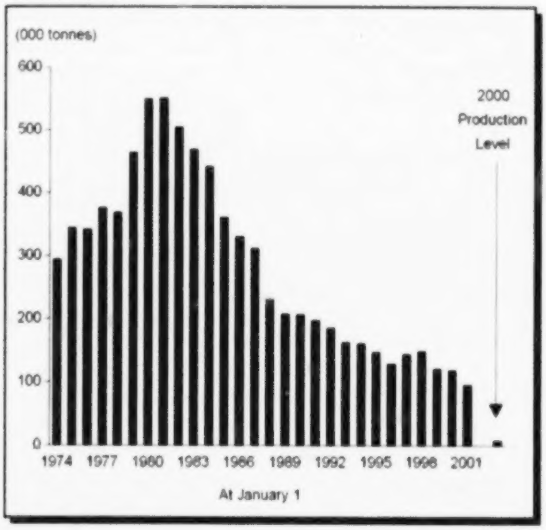
At present, Canada's silver production is entirely a by-product of base-metal and gold mining. The Eskay Creek gold-silver mine accounted for 41% of Canada's silver production in 2001. Canada's silver reserves have been mostly declining since the early 1980s when base-metal reserves began to decline. Silver reserves and silver production will continue to decline if base-metal reserves decline and the Eskay Creek mine comes to an end, unless significant new discoveries can be made.

Figure 25
Molybdenum Production, 1902-2000



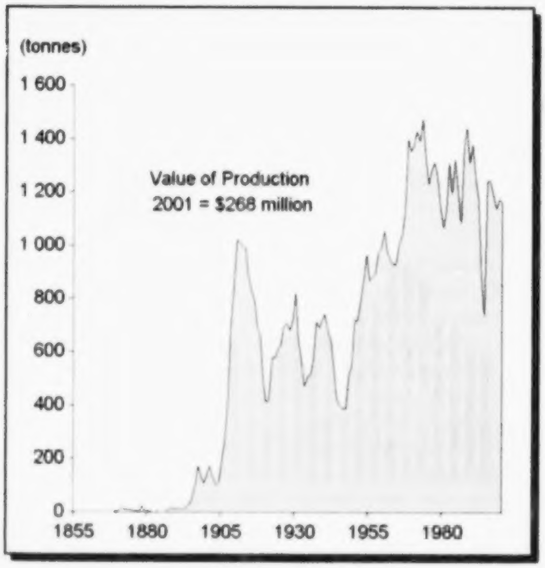
Source: Natural Resources Canada.

Figure 26
Molybdenum Contained in Mineable Ore, 1974-2001



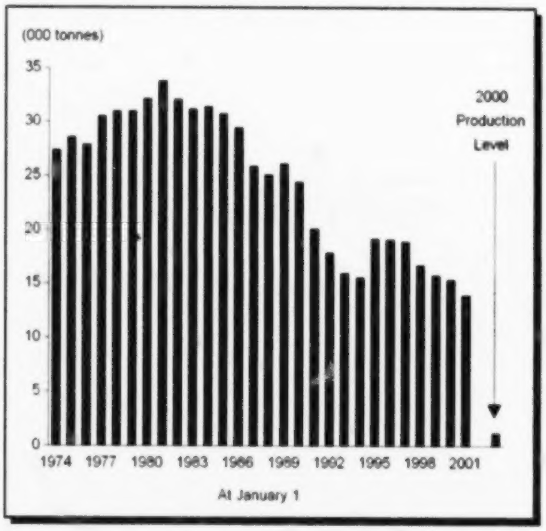
Source: Natural Resources Canada.

Figure 27
Silver Production, 1869-2000



Source: Natural Resources Canada.

Figure 28
Silver Contained in Mineable Ore, 1974-2001



Source: Natural Resources Canada.

Gold

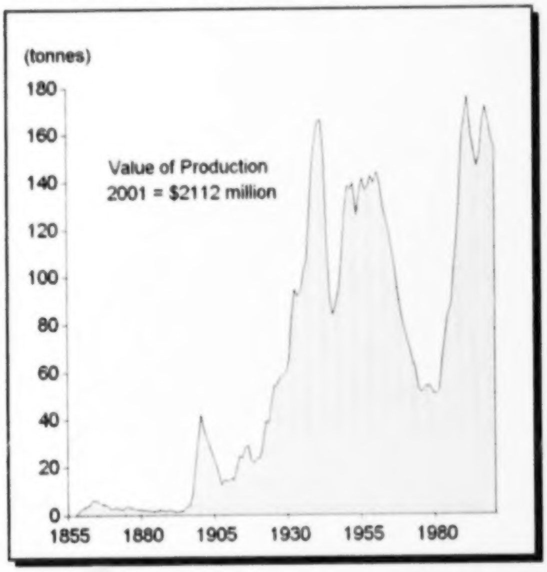
Canada's gold production is currently at close to record-high levels. When the gold price increased rapidly at the end of the 1970s, both reserves of gold in ore and gold production increased rapidly. Reserves have declined somewhat as gold prices have declined. The future of gold mining in Canada depends on higher gold prices, new discoveries, and the development of new gold mines. Gold prices generally rose throughout 2002 and 2003, resulting in increased exploration for gold.

Uranium

In 2001, Canada's uranium production totaled 12 992 t (preliminary), an all-time record production. Uranium production for 2001 is not shown in Figure 31 because the available total is only a preliminary estimate. If demand should exist, Canada's uranium output could increase from current levels and be maintained at higher levels for many years.

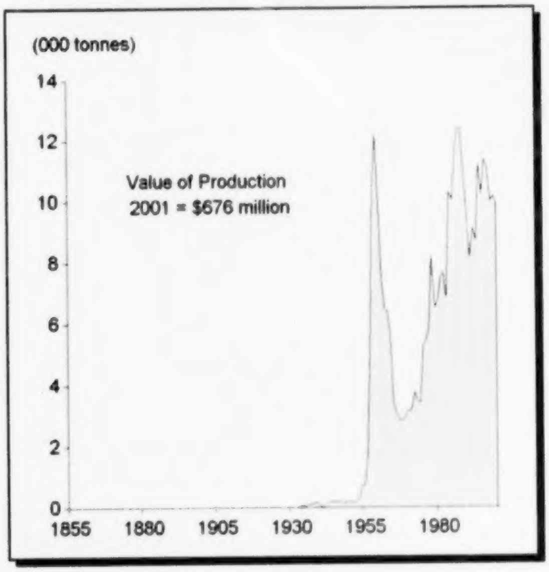
Canada's uranium resources are compiled and graphed, not uranium reserves, because the world's nuclear power producers want to know how much uranium will be available at prices they could afford to pay if they had to, rather than how much is available at current prices. Canada's uranium resources are high at present.

Figure 29
Gold Production, 1858-2000



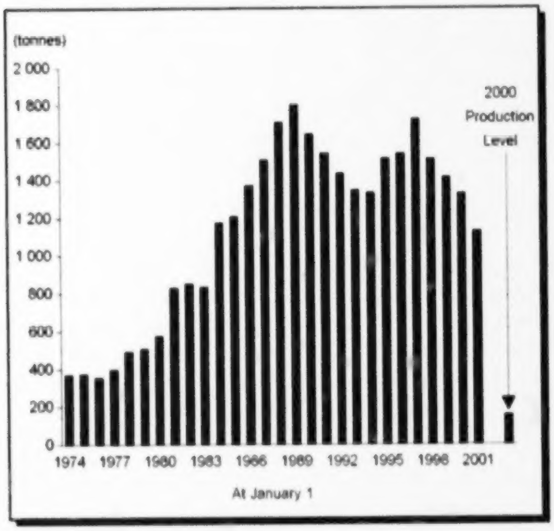
Source: Natural Resources Canada.

Figure 31
Uranium Production, 1933-2000



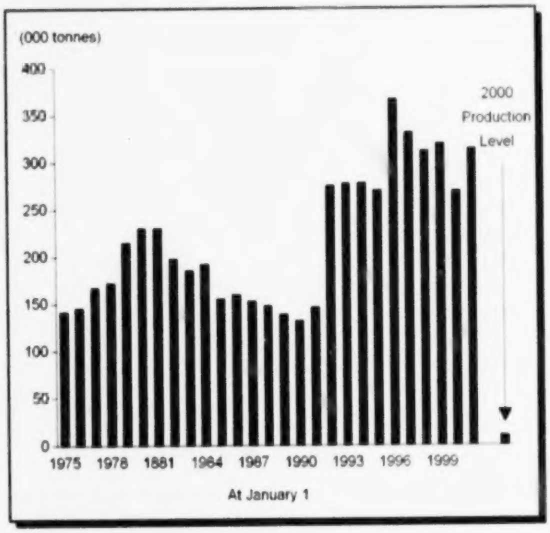
Source: Natural Resources Canada.

Figure 30
Gold Contained in Mineable Ore, 1974-2001



Source: Natural Resources Canada.

Figure 32
Measured and Indicated Uranium Resources



Source: Natural Resources Canada.
Notes: Resources recoverable at prices up to $100/kg of uranium. Prices are not adjusted for inflation. Prices used for 1975-83 varied from year to year.

Platinum Group Metals

Recently increased production from the Raglan Nickel Belt and from the North American Palladium mine will yield record production of platinum group metals. Such production can be sustained for 25 years or longer, although output from the North American Palladium operation could be affected by periods of low palladium prices.

Canada's reserves of platinum group metals are not compiled.

Cobalt

Production of cobalt from the new Voisey's Bay mine, together with recently increased production from the Raglan Nickel Belt, will yield record levels of Canadian cobalt production that can be sustained for longer than 25 years. Canada's reserves of cobalt are not compiled.

Iron Ore

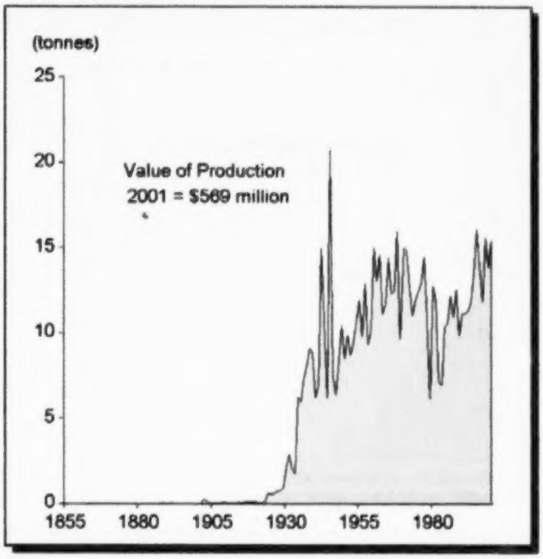
The peak in Canadian iron ore production over the period from the 1960s to early 1980s included production from the former Wabana mine in Newfoundland (where resources still exist but of material that no longer meets current grade and phosphorous content requirements) and from a number of other smaller mines in Quebec, Ontario and British Columbia at which ore reserves have been mined out.

Canada's current iron ore production is now entirely from the Labrador Trough (from two large mines in Labrador and one in Quebec). Iron ore reserves, resources and available production capacity are adequate to support higher than current production for many years to come.

Coal, Potash, Salt, Asbestos, Gypsum and Peat Moss

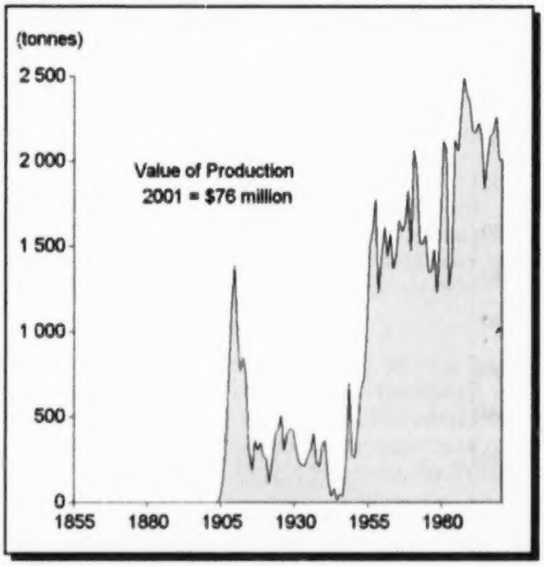
Figures 36 to 41 depict historical Canadian production of coal, potash, salt, asbestos, gypsum and peat moss. With the exception of asbestos, production of these mineral commodities has been increasing over the past several decades and is at or close to record production levels. Canada's undeveloped resources of all these mineral commodities is adequate to support much higher production levels. The sharp decline in Canadian asbestos production is related more to restrictions on the use of asbestos and the resultant declining markets. Canada has known, undeveloped asbestos deposits of grades comparable to those that have been mined and could produce more asbestos if market demand existed.

Figure 33
Platinum Group Metals Production, 1887-2000



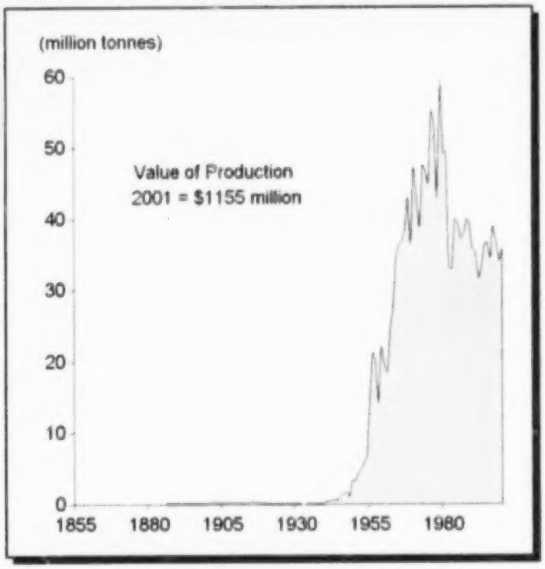
Source: Natural Resources Canada.

Figure 34
Cobalt Production, 1904-2000



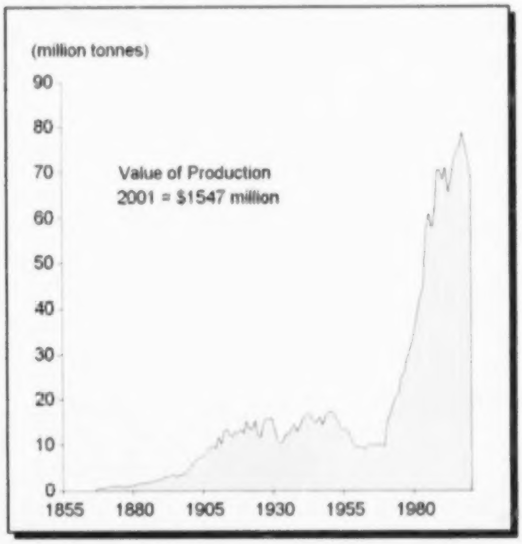
Source: Natural Resources Canada.

Figure 35
Iron Ore Production, 1886-2000



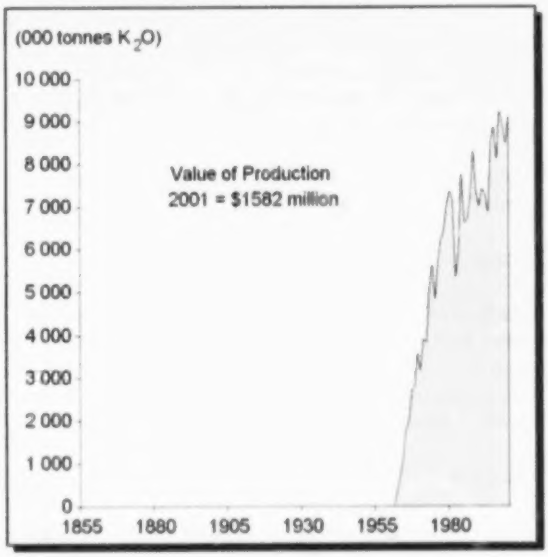
Source: Natural Resources Canada.
Note: Does not include about 50 Mt mined in Newfoundland between 1893 and 1949 before Newfoundland joined Canada.

Figure 36
Coal Production, 1867-2000



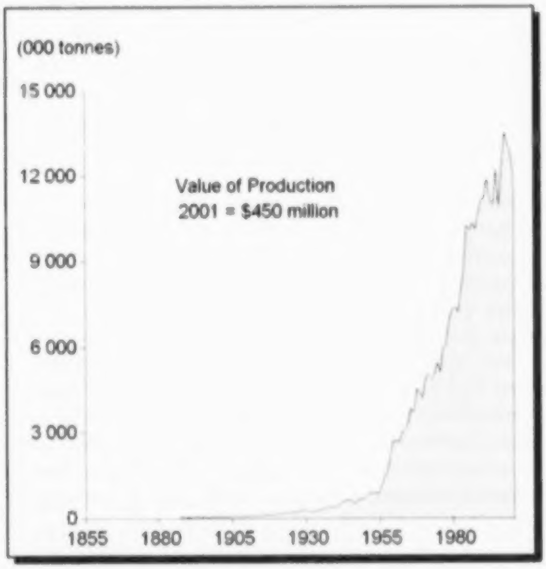
Source: Natural Resources Canada.
Note: Canada produced a cumulative total of 2.6 Mt of coal from 1785 to 1866.

Figure 37
Potash Production, 1858-2000



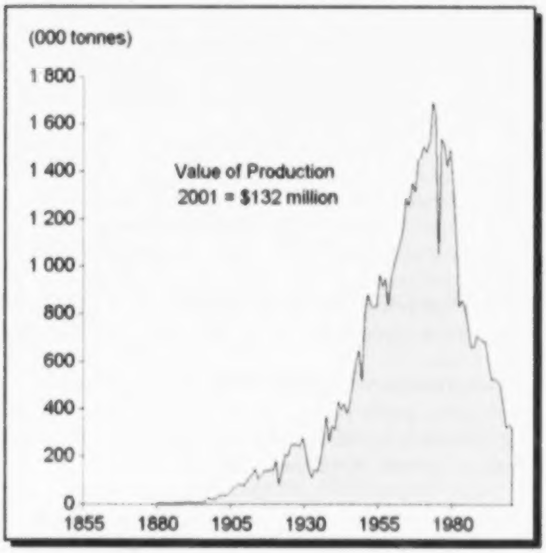
Source: Natural Resources Canada.
Note: The graph does not show the minor production from one mine in 1958 and 1959.

Figure 38
Salt Production, 1886-2000



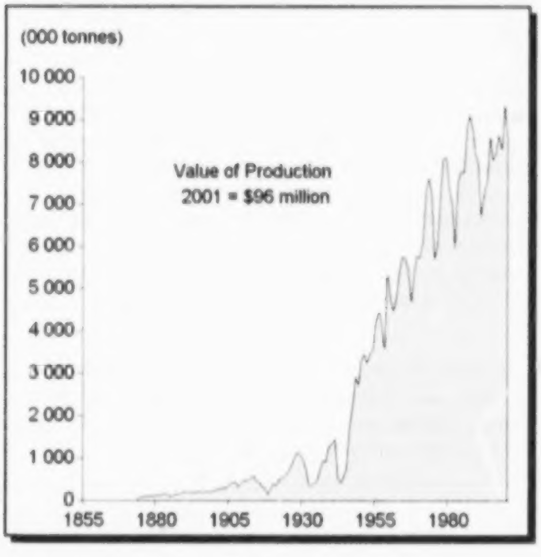
Source: Natural Resources Canada.

Figure 39
Asbestos Production, 1880-2000



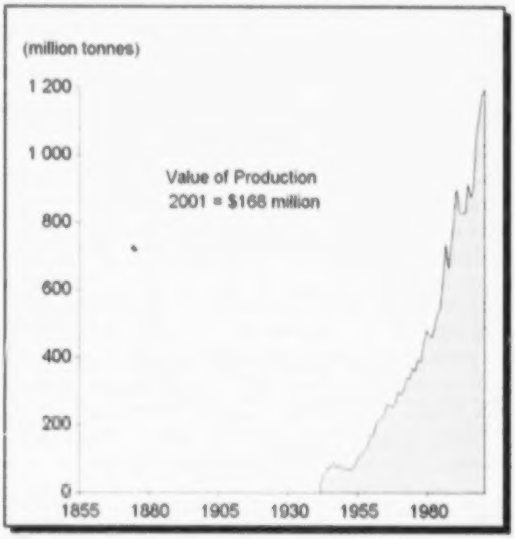
Source: Natural Resources Canada.

Figure 40
Gypsum Production, 1874-2000



Source: Natural Resources Canada.

Figure 41
Peat Moss Production, 1941-2000



Source: Natural Resources Canada.
Note: This graph does not include a cumulative total of about 40 000 t of peat fuel produced between 1900 and 1955.

SUMMARY, DISCUSSION AND CONCLUSIONS

In most of Canada's provinces and territories, provided mineral commodity prices are not too low over prolonged periods, the outlook for continuation of the mining industry over the next 25 years is reasonably good. But a continuous supply of new discoveries and new mines will be needed during those 25 years and beyond to sustain the mining industry.

Mineral commodity prices are set on world markets. Canada has little influence on, or control of, those prices, so there is little that can be done to avert temporary or permanent mine closures that result from periods of low prices.

Major problem areas for metal mining in the near future appear to be the Bathurst region of New Brunswick, the Abitibi region of Quebec, British Columbia metal mining in general (especially the porphyry-type deposits of copper, molybdenum and gold in the province), the Yukon, and Nunavut.

In New Brunswick, a total of 42 massive sulphide deposits have been discovered in the Bathurst region over the past 50 years. Massive sulphide discoveries continue to be made; the latest, the Mount Fronsac deposit discovered in 2001 (1.2 Mt averaging 7.65% zinc, 2.18% lead, 0.14%

copper, 40.3 g/t silver and 0.40 g/t gold) is too small to be viable. There is still hope for additional ore discoveries in the Bathurst region, so it is important that exploration continue there.

In Quebec's Abitibi region, without new ore discoveries, mining will soon begin to decline. However, over the past 15 years, a dozen mineable orebodies have been discovered there. It seems reasonable to expect that new orebodies will continue to be discovered. Higher levels of exploration will be required to ensure that a sufficient number of discoveries are made to maintain the Abitibi region's mining industry.

Several proposed new mines and mine re-openings in the Abitibi region, which are not shown in Figure 18 because future production from them does not seem certain, may yet help to maintain production from the region. These include Casa Berardi (gold), Copper Rand (copper-gold), East Amphi (gold), Corner Bay (copper), and a possible resumption of production at the former Kiena gold mine.

In British Columbia, most of the low-grade porphyry-type deposits being mined in the province have difficulty competing with higher-grade orebodies elsewhere in the world. The discovery of other higher-grade metal deposit types in British Columbia is essential.

In the Yukon, mining of placer gold is now the only remaining metal mining activity. Without adequate exploration, metal mining in the Yukon will eventually come to an end. In Nunavut, closure in 2002 of the Polaris and Nanisivik mines and the closure in 2003 of the Lupin gold mine left Nunavut with no mines. Several promising gold deposits have been discovered in Nunavut in recent years. Hopefully, some of these will be developed for production, with the Hope Bay project most likely to produce soon. Increased exploration will be needed to ensure the future of metal mining in Nunavut.

Except for the possible effects of current low metal prices, the future of the mining industry in Canada's other provinces and territories appears reasonably secure over at least the next 25 years. As always, mines will continue to have their ore reserves depleted and will close as those reserves are depleted. To have a mining industry that continues after 25 years will require a continuing flow of new mineral discoveries and the development of new mines. To make these new mineral discoveries, mineral exploration expenditures at historical or higher levels will be required.

From 1997 to 2001, exploration expenditures in Canada were significantly lower than the inflation-adjusted average expenditures of the previous 30 years. While there has been a modest recovery in 2002 and 2003, exploration levels are still low relative to the long-term historical expenditures.

Discovering orebodies in Canada is becoming increasingly more expensive (in inflation-adjusted terms). Therefore, exploration expenditures in Canada (as well as in most other countries where discovery costs are also getting higher) need to be higher, not lower, than long-term historical expenditures. Both in inflation-adjusted dollar terms and as a percentage of Canada's mineral production value, exploration expenditures have been declining. There are several reasons for the recent decline in exploration expenditures in Canada:

- The many large, highly attractive mineral deposit discoveries made elsewhere in the world in recent years have diverted exploration funds from Canada.
- With most metal prices low, most metal-producing companies have had to cut back on exploration.
- With metal prices low, it has been difficult for junior exploration companies to raise the exploration funding they need.
- Mining company mergers and takeovers have removed exploration participants. The newly formed companies are invariably spending less on exploration than the previously separate companies were.

Another factor that must be taken into account in determining the levels of exploration expenditures needed to sustain the Canadian mining industry is that when metal prices are low, only the very best of the deposits discovered will be economically viable. This means that higher-than-normal levels of exploration will be needed to ensure that we find the orebodies needed to maintain Canada's ore reserves and current production levels of metals.

In only a few years, without new discoveries and the development of new mines, Canada's production of copper, zinc, lead, molybdenum and silver will decline sharply. The production of lead and molybdenum may even cease completely. Declining production of copper, zinc and lead concentrates will leave existing copper smelters in Quebec and Ontario, a lead smelter in New Brunswick, a copper refinery in Montréal, and zinc refineries in Quebec and Ontario partially or completely dependent on imported metal concentrates. Under such conditions, more of these facilities are likely to follow the Gaspé copper smelter in closing their operations.

Notes: Information in this review was current as of May 2003. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/2002cmy_e.htm.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Aluminum

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(Notes: General material on aluminum is available on the Internet at www.nrcan.gc.ca/mms/scho-ecol/main_e.htm#aluminum and in the 2000 chapter on Aluminum at www.nrcan.gc.ca/mms/cmy/com_e.html. Abbreviations of company names used in this paper are listed in Table 10 along with known Internet addresses of those companies.)

Canada's rank in world production of metal:	Third
Installed capacity:	2.79 Mt/y

	Amount	Value
2002 primary aluminum production:	2.71 Mt	$5.7 billion^{P}
2002 exports (unwrought):	2.1 Mt	$4.9 billion^{P}
2002 exports (HS Chapter 76)[1]:	n.a.	$8.4 billion^{P}

n.a. Not applicable; ^{P} Preliminary.

Increases in production at existing and new facilities around the world have now surpassed the cutbacks in metal production that occurred in the Americas in 2001. As a result, world production of primary and recycled aluminum has increased in 2002 to an estimated total of 33.8 Mt, compared to the past record 32.7 Mt in 2000. Of this total, 25.9 Mt was primary metal, compared to 24.5 Mt in 2001.

Although the average price was lower in 2002 compared to 2001, prices were less volatile and remained within a trading range of about 10% during 2002. Prices declined in June and started to recover in October, ending the year at prices close to those at the start of year (refer to the table below).

PRIMARY ALUMINUM CASH PRICE, LONDON METAL EXCHANGE

	2000	2001	2002
		US$/t (USc/lb)	
Year average	1 555 (71)	1 444 (66)	1 349 (61)
Start of year	1 615 (73)	1 567 (71)	1 324 (60)
End of year	1 554 (71)	1 335 (61)	1 345 (61)
Year high	1 745 (79)	1 737 (79)	1 438 (65)
Year low	1 400 (63)	1 243 (56)	1 276 (58)

Prices in the spot alumina market reached a bottom in late 2001; after revisiting the lows in October 2002, prices started to rise as smelter expansions, particularly in China, placed increased demand on spot markets. *Metal Bulletin* reported that spot prices for metallurgical-grade alumina started the year at US$130-$140/t, rose to US$150-$160/t in mid-year, fell back to US$138-$143/t in October, and subsequently rose to US$240-$270/t in early 2003.

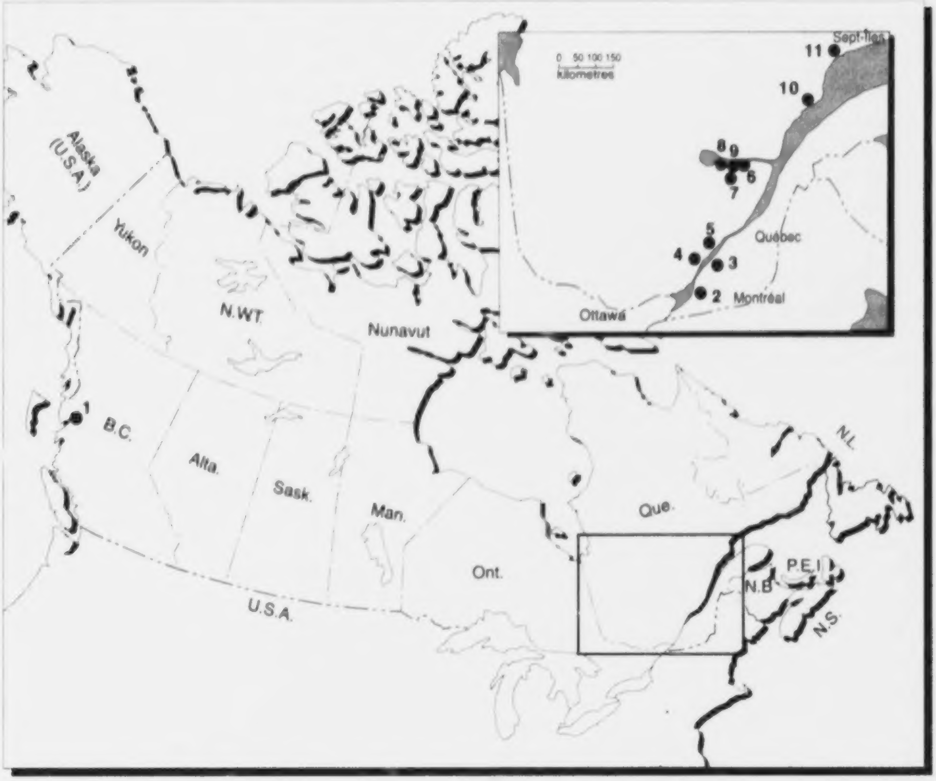
CANADIAN DEVELOPMENTS

Production of primary aluminum in Canada increased 4.9% to 2.71 Mt in 2002, compared with 2.583 Mt in 2001, ranking Canada third after China and Russia in terms of world primary production. The increase reflects a full year of operation at Alcan Inc.'s 400 000-t/y smelter in Alma, Quebec, which reached full operating capacity in September 2001. Monthly Canadian production statistics can be obtained on Natural Resources Canada's Internet site (http://mmsd1.mms.nrcan.gc.ca/mmsd/data/default_e.asp).

The value of Canadian primary aluminum production in 2002 is estimated at $5.7 billion, down slightly from $5.8 billion in 2001, reflecting the larger decrease in prices for aluminum when compared with the increase in production level.

Reported Canadian use of aluminum metal at the first processing stage, including the use of recycled aluminum,

Figure 1
Aluminum Smelters, 2002


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
1
Alta.
Sask.
Man.
Ont.
Que.
N.L.
P.E.I.
N.B.
N.S.
U.S.A.
0 50 100 150
kilometres
Sept-Îles
11
10
8
9
6
7
5
4
3
2
Québec
Montréal
Ottawa

Smelter	Company	Capacity (t/y)
1. Kitimat	Alcan	275 000
2. Beauharnois	Alcan	50 000
3. Bécancour	A.B.I.	390 000
4. Shawinigan	Alcan	91 000
5. Lauralco Deschambault	Alcoa Lauralco	240 000
6. Grande-Baie	Alcan	196 000
7. Laterrière	Alcan	219 000
8. Alma	Alcan	400 000[a]
9. Arvida, Jonquière	Alcan	248 000
10. Baie-Comeau	Canadian Reynolds Metals (Alcoa)	437 000
11. Alouette, Sept Îles	Alouette	244 000
		2 790 000

---

[a] Reached full capacity in mid-2001.

was 945 336 t in 2001, down from a revised figure of 1 012 816 t in 2000[2] (Table 3a). The data revisions for 2000 and part of the decrease in 2001 are due to revisions in the survey to clarify and exclude run-around scrap from reported use.

Canada is the second largest aluminum-exporting country in the world after Russia. Canadian exports of primary smelter products in 2002 increased in quantity to 2.13 Mt valued at $4.937 billion (US$3.14 billion), compared to 2.05 Mt valued at $4.914 billion (US$3.17 billion) in 2001. Of this amount, unwrought exports to the United States totaled 1.61 Mt valued at $3.78 billion (US$2.4 billion) (see Table 1).

The Canadian aluminum industry has made major strides in reductions in greenhouse gas emissions per tonne of aluminum produced over the last 10 years. Industry reports the intensity of emissions per tonne of aluminum has fallen from 5.59 t of CO_2 equivalent[3] (CO_2e) in 1990 to 3.94 t in 2000. However, total emissions have not fallen in the same proportion due to increased production of metal over the period. In January 2002, the Aluminium Association of Canada and the Quebec government signed a framework agreement on the voluntary reduction of 200 000 t of CO_2e emissions from Quebec smelters by the end of 2007. However, subsequently, company-specific agreements were signed with Alcan, Alcoa and Alouette, which further detail company-specific reduction targets actually totaling 500 000 t of CO_2e. The agreements acknowledge the importance of aluminum's life cycle and contribution to the collective effort to reduce greenhouse gas emissions. Refer to the Association's web site at www.aia.aluminium.qc.ca for further details and links for additional information.

In early 2002, after discussions with Quebec aluminum companies, the Quebec government chose an expansion proposal by Aluminerie Alouette Inc. and Alcan Inc. and allocated 500 MW of power (at standard regulated commercial rates) to the company. Aluminerie Alouette plans to invest $1.4 billion to expand capacity of its smelter from 244 000 t/y to 550 000 t/y. Preliminary work began in late 2002 and the first metal is expected in 2005. In addition to the 2500 construction jobs, the expansion will create 340 permanent new jobs at the smelter and 1500 indirect jobs in other areas of the province. Further details are on the company's web site at http://www.alouette.qc.ca.

Alcoa signed an agreement with the Quebec government in December 2002 to upgrade the 437 000-t/y Baie Comeau smelter. The agreement provides the additional power required for the operation of pre-baked cells, which will replace existing Söderberg technology. Construction of the $1 billion upgrade to the smelter will begin in 2003 with completion expected in 2010. The capacity of the smelter is expected to increase by 110 000 t/y to 547 000 t/y. Modernization and construction work will create over 5000 direct and indirect jobs over the eight years of work.

Alcoa also signed a Memorandum of Understanding with the Quebec government on March 5, 2003, on the expansion of the Deschambault smelter (Lauralco) located near Québec City. Alcoa wishes to expand the smelter from 240 000 t/y to a capacity of 570 000 t/y. If power is available, the expansion will entail an investment of more than $1 billion and the creation of 9000 direct and indirect jobs for the length of the construction period. Alcoa agreed to create a minimum of 1250 jobs, most of which will be in the Quebec aluminum fabricating industry, and more than 250 jobs with the expansion of the Deschambault plant.

Alcan signed a Memorandum of Understanding with Hydro-Québec in February 2002 to explore opportunities. These range from optimizing hydro-electric resources in the Saguenay–Lac-St-Jean region to providing the power to support the eventual expansion of Alcan's Alma smelter.

Alcan's 275 000-t/y smelter at Kitimat, British Columbia, suffered from low water levels in the Nechako Reservoir. The company had announced a slowdown, of up to 50% of the facility's capacity, in 2001 and, in June 2002, Alcan announced a partial restart from 180 000 t/y to 240 000 t/y. During the slowdown, Alcan worked on studies for an expansion and pilot work on converting the smelter to pre-bake technology (www.alcan.com).

In 2001, Alcoa Inc. signed a letter of intent with the Province of Newfoundland and Labrador and with Newfoundland and Labrador Hydro on a joint review of a possible hydro-electric power expansion in Labrador and a new aluminum smelter. The review was completed in late 2001 and discussions continued in 2002, but the parties have now terminated negotiations without reaching an agreement (www.alcoa.com, www.gov.nf.ca, and www.gov.nf.ca/releases/2002/mines&en/0729n04.htm).

In British Columbia, the Alberni Aluminium Company has been formed to continue work on a proposal for a 360 000-t/y aluminum smelter. KTD L.L.C., an independent U.S.-based consulting firm, is providing engineering and design services and management/operations expertise. In 2002, the companies completed a pre-feasibility study for a new smelter to be located near Port Alberni, Vancouver Island. Work continued on environmental and engineering studies, a long-term power supply, and finding investors for the project. The proposed smelter would require 650 MW of power and new infrastructure. Engineering and permitting studies were estimated to take up to three years. Construction is expected to take 34 months and, as a result, initial metal production would not occur before 2008. A total of 650 direct jobs and a substantial number of indirect jobs would be created with this proposed US$1.5 billion smelter. (Additional information is available on the Internet at www.bchydro.bc.ca, www.alberni-region.com and www.ktdal.com).

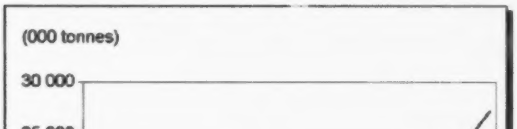
Alcan purchased a 20% share of the Alouette smelter from the Société générale de financement du québec (SGF) and a 20% interest from Corus Aluminium Québec Inc. SGF purchased a 13.33% interest from Kobe Aluminium Canada Inc. As a result of Norsk Hydro ASA's purchase of VAW AG from E.ON, the new Hydro Aluminum group, Hydro Aluminum, now owns 20% of the smelter. The remaining partners in Alouette are Aluminium Austria Metall Québec (20%) and Marubeni Québec Inc. (6.66%).

CANADIAN OUTLOOK

Although Canadian aluminum production capacity increased substantially during the latter half of the 1980s and early 1990s, it remained relatively stable until Alcan's new Alma smelter opened in 2001. Canada's production capacity increased slightly to 2.79 Mt/y by the end of 2002 as capacity creep[4] was reported in several smelters. With the announcements of expansions at the Alouette, Baie Comeau and Lauralco smelters, Canadian capacity could surpass 3 Mt/y by 2005 and 3.6 Mt/y by 2010. Other potential smelter expansion projects would be in excess of the capacities noted above and are dependent on power supplies and favourable company decisions. Decisions on potential new capacity in British Columbia and elsewhere are still pending.

Canada is expected to produce about 2.75 Mt of primary aluminum in 2003, up slightly from 2002. The increase will result from capacity creep in existing smelters; however, reaching this level will also depend on power availability to the Kitimat smelter in northern British Columbia.

Figure 2
World Total Primary Aluminum Production, 1965-2002 (e)



Sources: Natural Resources Canada; International Consultative Group on Nonfrrous Metals Statistics.
(e) Estimate for 2002.

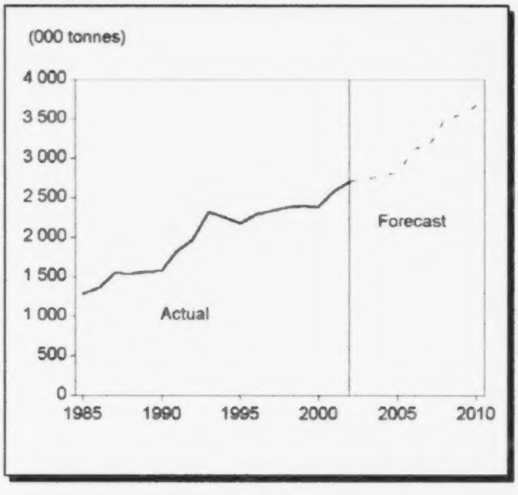
PRODUCTION, USE AND INVENTORY

World production of primary aluminum increased to 24.51 Mt in 2001 from 24.46 Mt in 2000 (see Table 8). World production in 2002 is estimated to have risen by about 5.8% to 25.9 Mt. The International Consultative Group on Nonferrous Metal Statistics reported that total world use of primary aluminum was 23.8 Mt in 2001, 4.6% lower than the revised figure of 24.9 Mt for 2000 (Table 9). On a longer-term basis, the average daily production rate has been growing at about 2% per year since 1980 (See Figure 2).

The World Bureau of Metal Statistics (WBMS) reported that, in 2002, use of primary aluminum was 24.9 Mt. Asia was the region in the world with the largest aluminum use, accounting for 38% of total world refined aluminum use. Europe accounts for 30% and North America accounts for 24%.

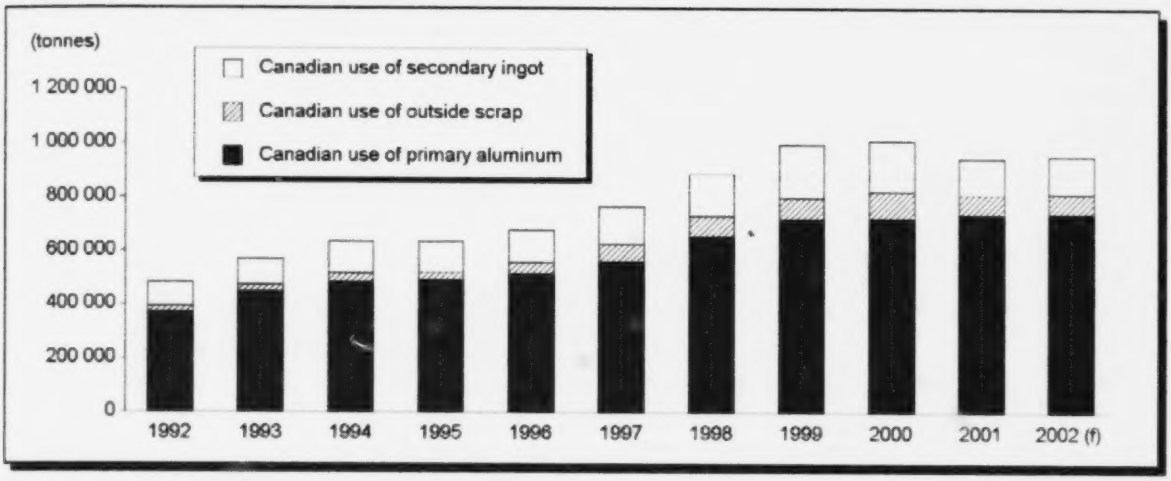
Production of International Aluminium Institute (IAI) members reached 21.2 Mt in 2002 (~86% of world production). Their primary aluminum production rate increased 5.7% during the year to 59 300 t/d in December

Figure 3
Canadian Primary Aluminum Production, 1985-2010



Source: Natural Resources Canada.

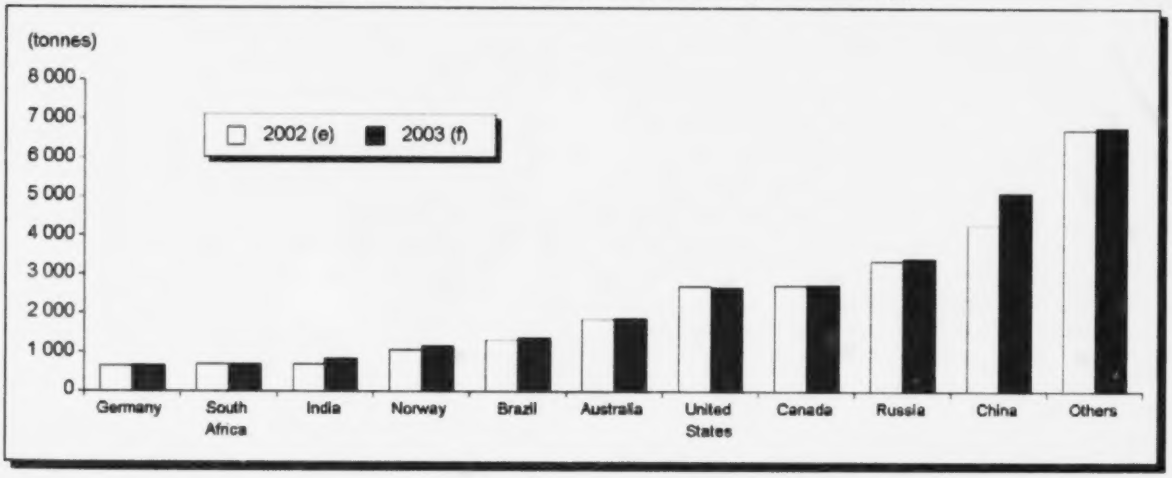
Figure 4
Reported Canadian Use of Aluminum, 1992-2002



Source: Natural Resources Canada, Annual Survey of Aluminum Metal Use in Canadian Establishments.
(f) Forecast.

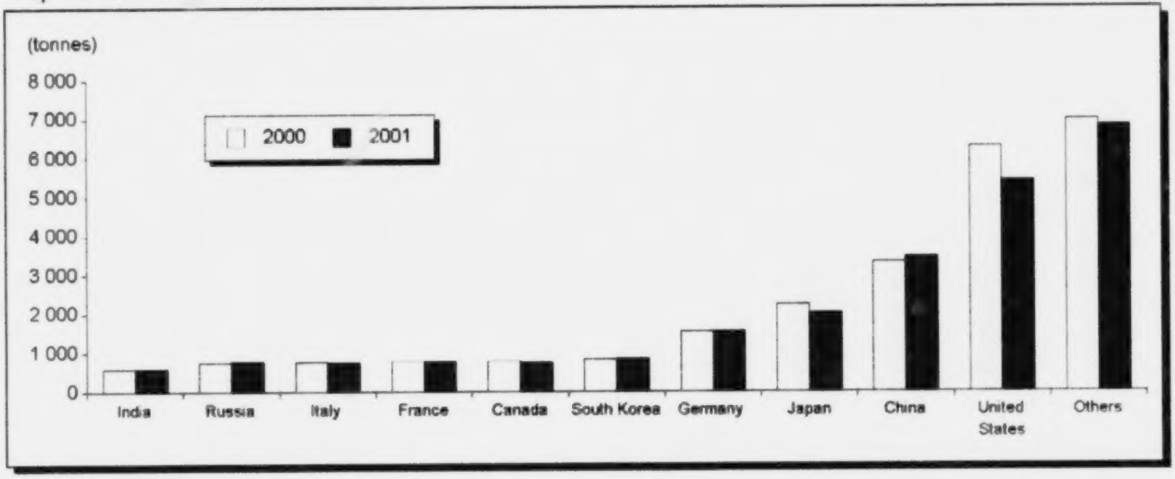
Notes: Export figures are obtained from Canadian government trade data. Data on metal use are obtained from responses to questionnaires sent to aluminum-using companies. In 2000, over 185 Canadian companies used primary, recycled and scrap aluminum. Companies surveyed include primary metal producing, recycling, casting, rolling, extruding and foundry operations.

Figure 5
Primary Aluminum Production, Top Ten Producers, 2002 (e) and 2003 (f)



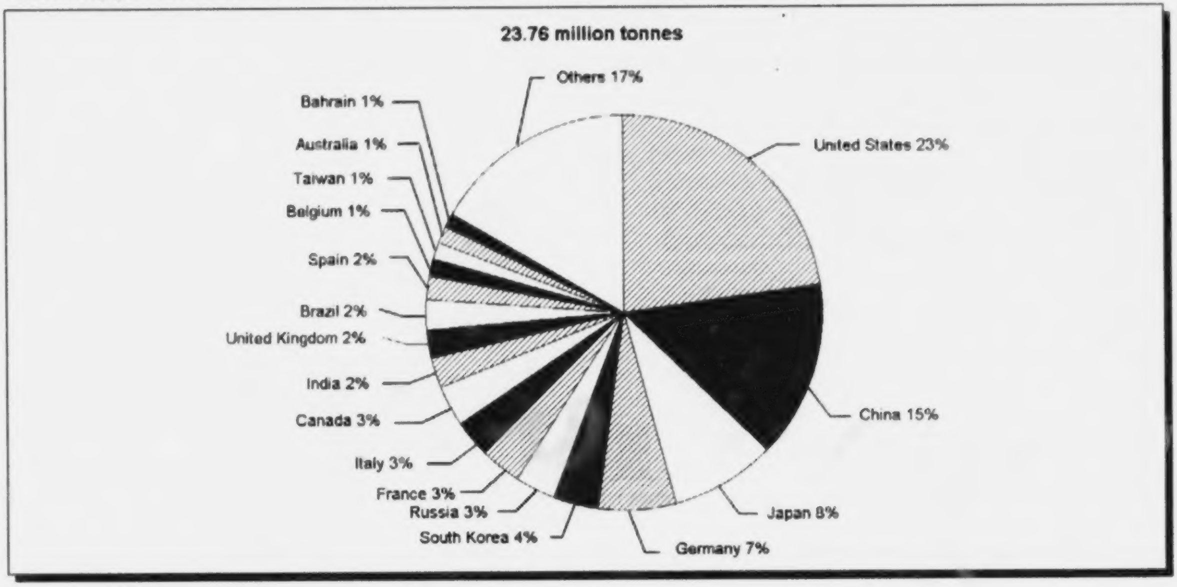
Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; World Bureau of Metal Statistics; International Aluminum Institute.
(e) Estimate; (f) Forecast.

Figure 6
Apparent Use of Primary Aluminum, 2001
Top 10 Countries - 80% of Total



Source: International Consultative Group on Nonferrous Metals Statistics.

Figure 7
Total Apparent Use of Primary Aluminum by Country, 2001



Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.

2002 from 56 100 t/d in December 2001. The average production rate for all of 2002 was 58 100 t/d, compared with an average of 56 300 t/d in 2001 (an increase of 3.2%). Members' aluminum production capacity increased from 22.976 Mt/y at the end of 2001 to 23.108 Mt/y at the end of 2002. (The IAI has an Internet site at www.world-aluminium.org.)

IAI total inventories started the year at 3.0 Mt and then declined to 2.86 Mt in July, remaining at that level until November, with a slight increase to 2.9 Mt in December. LME primary aluminum inventories continued to increase, continuing a trend that started in 2000. High-grade inventories started the year at 824 000 t and increased steadily to peak at 1.30 Mt in September, declining slightly thereafter to end the year at 1.24 Mt. Similarly, aluminum alloy stocks in LME warehouses in January 2001 were approximately 86 000 t and increased during the year to 121 000 t in December. Aluminum alloy stocks in LME warehouses started in January 2002 at about 122 000 t and declined throughout the year to 35 000 t at the end of December.

The IAI also reported that members' refined[5] alumina production capacity increased from a revised 53.305 Mt/y in December 2001 to 53.615 Mt/y in December 2002, while alumina production also rose from 48.488 Mt in 2001 to 49.785 Mt in 2002.

WORLD DEVELOPMENTS

China continues to expand production capacity; it became the largest producer of primary aluminum in the world in 2001 and increased its lead in 2002 when it produced 4.2 Mt. This rapid increase in production has placed upward pressure on alumina prices globally and has increased power costs within China. Government pressure continues on older smelters to close or modernize. Chinese primary aluminum production is expected to be above 5 Mt in 2003, firming up China's global lead.

In the northwestern United States, questions about power availability and costs continue to be issues for smelters. Financial strains on the Bonneville Power Authority (BPA) have continued and this has led BPA to announce in early 2003 that it intends to increase rates to large customers by 15% in late 2003. While BPA power costs and availability have been an issue for the last two decades, the recent increases may be the final straw for a number of smelters. Reports of permanent and indefinite closures have started to appear. Kaiser Aluminum's plants in Mead and Tacoma have been closed and Alcoa's plans in Ferndale (Intalco) to re-open a third potline have been put on hold. About 1 Mt/y of the total U.S. annual primary capacity of approximately 3.7 Mt/y remains closed.

A lack of rainfall in Brazil forced rationing of power in mid-2001, resulting in temporary closure for about 350 000 t/y of the country's capacity of 1.38 Mt/y. By year-end, however, restarts had begun and were nearly completed by the end of the first quarter of 2002. Production in 2002 was approximately 1.3 Mt.

The Russian parliament proposed an end to tax exemptions on the tolling of aluminum.[6] If implemented, this change in taxation could result in a slowing of expansions and modernization in Russian smelters.

Expansions, proposals and studies for new mines, refineries and smelters have been announced in many countries. Although the current high spot alumina prices (US$240-$270/t in early 2003) may delay some projects in China, a significant amount of new production capacity is expected in the near future. These new projects are expected to place increasing pressure on both operating and proposed plants with higher costs to reduce those costs or close. A partial listing of changes is tabulated in Tables 11 and 12.

The Federation of Aluminium Consumers in Europe (FACE) continued its efforts to stimulate aluminum demand by promoting the use of aluminum, assessing the impact of new technologies, and reducing the costs of primary metal through tariff reductions. FACE was formed in 1999 and has 42 members from European aluminum-using companies from 11 countries. As the European Union (EU) uses more than double the amount of primary aluminum it produces, FACE estimates that the EU's 6% duty on unwrought aluminum imports costs European consumers US$475 million per year. In 2002, FACE investigated the possibilities for legal action in the EU Court of Justice and continued its lobbying efforts in the EU, concentrating on the World Trade Organization to remove the tariffs. (FACE has an Internet site at www.facealuminium.com.)

RECYCLING

The WBMS reports Western World production of recycled aluminum metal increased to 7.9 Mt in 2002 from 7.7 Mt in 2001. This reflects a combination of the increased prices and demand for aluminum alloys. U.S. production, at 3 Mt, was the largest amount in any one country and represented almost 40% of recycled aluminum production worldwide. The U.S. Geological Survey has an Internet site at http://minerals.usgs.gov/minerals/pubs.)

Hydro Aluminium has opened a new 90 000-t/y plant producing primary-quality billet in Commerce, Texas, using a feed of high-quality scrap aluminum. The plant was expected to reach full capacity early in 2003. Its opening follows the completion of another recycling plant in Henderson, Kentucky, in 2000. The Texas plant expands

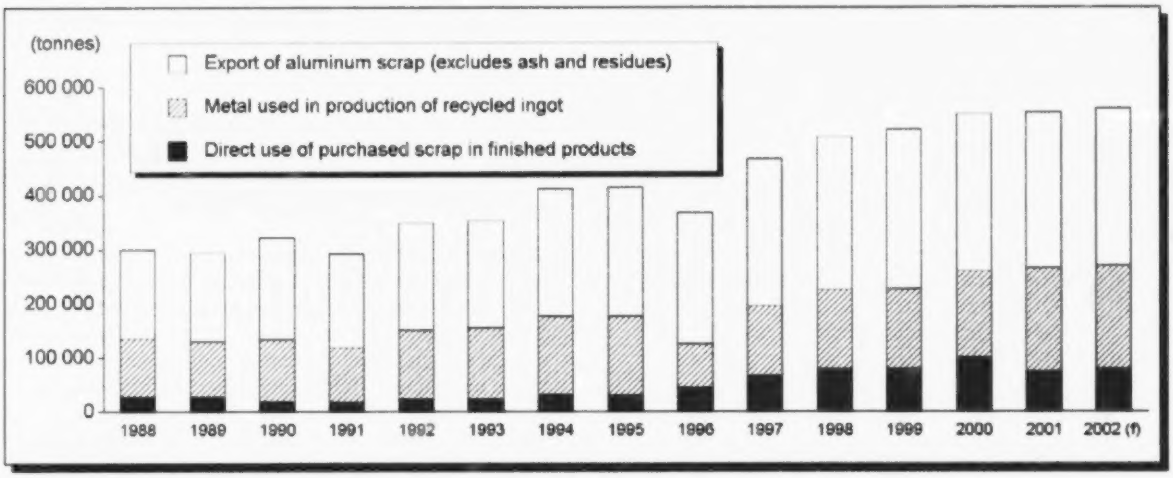


Figure 8
Canadian Recycling of Aluminum, 1988-2002

Source: Natural Resources Canada, Annual Survey of Aluminum Metal Use in Canadian Establishments.
(f) Author forecast for 2002.
Notes: Export figures are obtained from Canadian government trade data. Data on metal use are obtained from responses to questionnaires sent to aluminum-using companies. In 2001, 185 Canadian companies reported the use of primary, recycled and scrap aluminum. Companies surveyed include primary metal producing, recycling, casting, rolling, extruding and foundry operations.

Hydro Aluminium's recycling capacity in North America to over 400 000 t/y.

Reported Canadian use of outside scrap (scrap aluminum obtained from other companies) for the direct production of semi-finished or finished products was 74 923 t in 2001, down approximately 25% from the 100 294 t reported in 2000. The reported use of aluminum metal, including scrap used in the production of recycled aluminum ingot, was 175 470 t in 2001, up from the 159 419 t reported in 2000. The reported use of purchased recycled aluminum ingot was 134 483 t in 2001, down from the 190 026 t reported in 2000 (see Table 3b and Figure 5 on Canadian Recycling of Aluminum, and Figure 4 on Canadian Use of Aluminum).

A study of available data on Canadian used beverage can (UBC) recycling was conducted for the Aluminium Association of Canada in 2002. The 4.8 billion aluminum cans sold in Canada in 2001 contained approximately 72 000 t of aluminum.[7] The report indicates that about 72% of this aluminum was recovered through residential curb-side and deposit systems. Provincial recovery rates range from 71% to 94%. Much of the material is lost through disposal at purchases and activities away from home where collection and separation problems hamper metal recovery. UBCs, now sent for disposal, represent a potential income opportunity through the development of new or improved collection systems. Over the last year, the price of alloyed aluminum has risen compared to the price of primary aluminum. If this relative increase in value is maintained in the longer term, there may be an increased payback and incentive for recycling programs to be extended to commercial events.

Nova Pb Inc. is a Canadian recycler of lead, oil filters and petrochemical wastes located in Ville Ste-Catherine, Quebec. Nova received environmental approvals and an operating permit to expand its operations to include the recycling of spent potliners from aluminum smelters. The company has developed a proprietary process to recycle spent potliners using a long rotary kiln and converting the lining to an inert material called CAlSiFrit™. CAlSiFrit™ is used in concrete where it partially replaces the cement, improving the rheological and mechanical properties of the resulting concrete and reducing permeability by as much as 50%. The company plans to recycle 35 000 t of this material in 2003 and could expand this to 70 000 t in 2004. Nova has an Internet site at www.novapb.qc.ca.

Statistics Canada, Natural Resources Canada and the Canadian Association of Recycling Industries (http://cari.recycling.org) are managing a process to improve Canadian recycling data. The existing data collection is being examined so that information presently collected can be integrated into a collection of statistics on recycling. In addition, work is also under way on determining the feasibility of obtaining new data regarding the composition and sources of discarded materials (www.recycle.nrcan.gc.ca/stats_e.htm).

Metals recycling information can be obtained through Natural Resources Canada's web site at www.recycle.nrcan.gc.ca. The web site includes a listing of companies involved in recycling activities and provides an opportunity for recycling companies to add themselves to the list.

PRICES AND OUTLOOK

For alumina, IAI figures show that the alumina production capacity of its members is expected to increase from 53.6 Mt/y in December 2002 to 55.3 Mt/y in December 2003.

Primary-grade aluminum has established a longer-term price range, ranging between approximately US$1200 and $1800/t (US55¢ and 82¢/lb) since 1993. More recently, London Metal Exchange (LME) cash settlement prices have trended down from a peak above US$1700/t in early 2001 to trade in a range between US$1276 and US$1438/t (US58¢ and 65¢/lb) during 2002. The 2002 average of US$1349/t (US61¢/lb) was lower than the 2001 average of US$1444/t (US66¢/lb).

Aluminum alloy daily settlement prices on the LME increased during 2002 and have surpassed prices for primary material early in 2003. The increase in prices for longer contracts, however, has approached the price of primary material. Aluminum alloy settlement prices started 2002 at US$1035/t (US47¢/lb) and increased to end the year at US$1337/t (US61¢/lb). For 2002, alloy prices averaged approximately US$1234/t (US56¢/lb) compared to an average of approximately US$1174/t (US53.3¢/lb) in 2001 (see Figures 9 and 10).

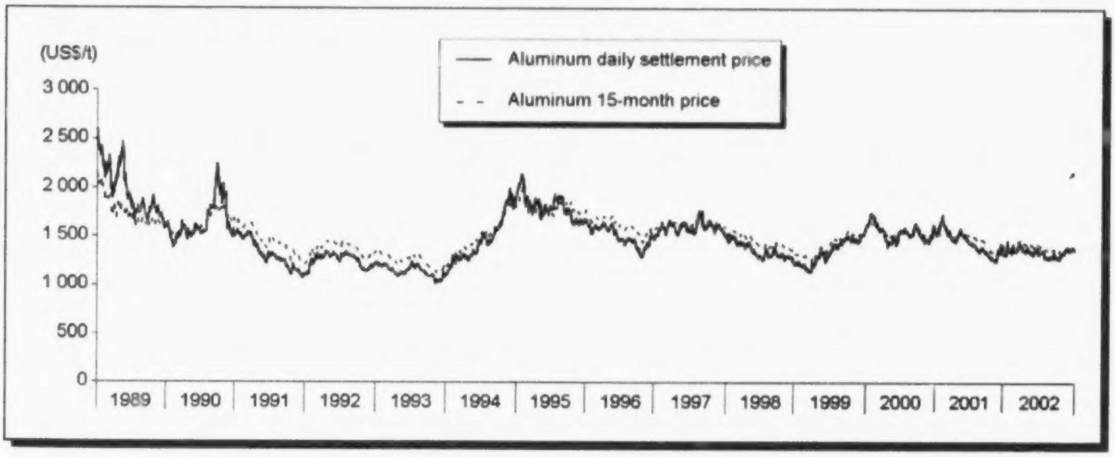
IAI figures show that the world primary production capacity of its members is expected to increase by about 1.8% to 23.5 Mt in December 2003 from 23.1 Mt at the end of 2002, with a slightly higher increase (3.4%) in 2004.

Taking into account the projected increases from non-IAI members, world primary production is expected to rise by approximately 5% to about 27.2 Mt in 2003. This increase and that of 6% in 2002 followed a half of a percent decline in 2001, and the increase is slightly above the long-term rate. The projected increases in production suggested by Table 12 indicate that this production increase may continue at a rate of 5% for 2004 and 2005. It is possible that the declines in prices since 1994 have supported an increased long-term growth rate in aluminum production.

Over the long term, the increasing production from larger, more efficient smelters is likely to continue the long-term trend to lower production costs and prices. Given the increases in production capacity planned over the next three years, it is probable that prices will remain under pressure, which will likely further stimulate additional demand, particularly in the transportation sector.

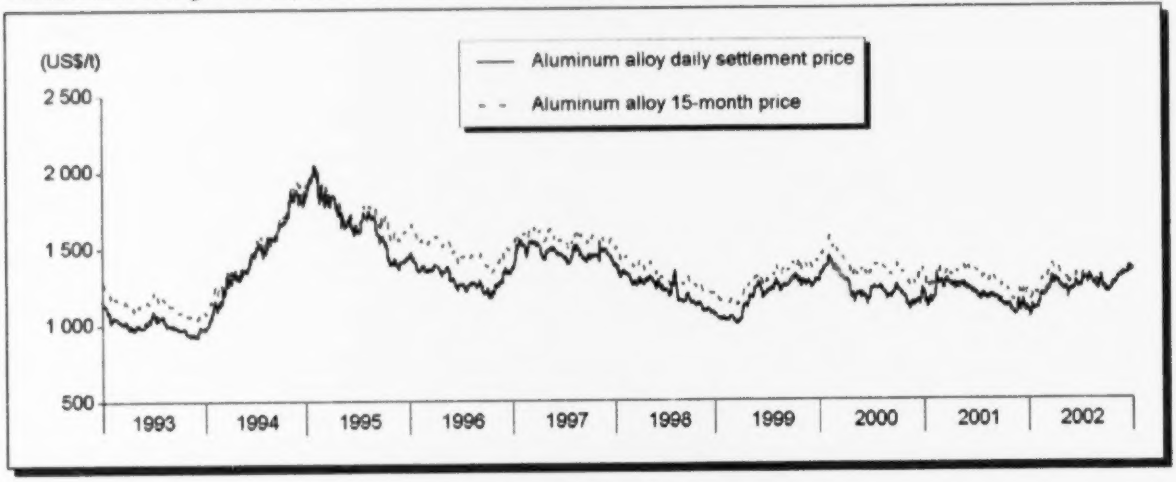
Canadian installed capacity for the production of primary aluminum is almost 2.8 Mt/y. With the announced expansions at Alouette and announcements on Baie Comeau and Deschambault, Canadian production rates are expected to increase to about 3.1 Mt/y in 2006. Studies have been undertaken on other Canadian brownfield expansions and new smelters. Should economic conditions warrant, further expansion in production could be possible.

Figure 9
London Metal Exchange Aluminum Prices, 1989-2002



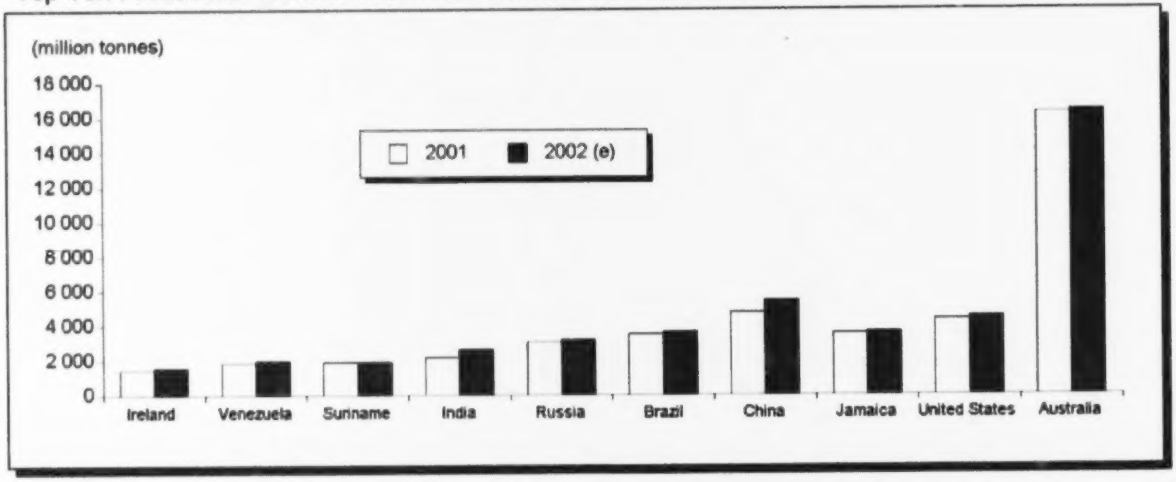
Sources: Natural Resources Canada; London Metal Exchange; Reuters; Metalprices.com.

Figure 10
Aluminum Alloy Prices, London Metal Exchange, 1993-2002



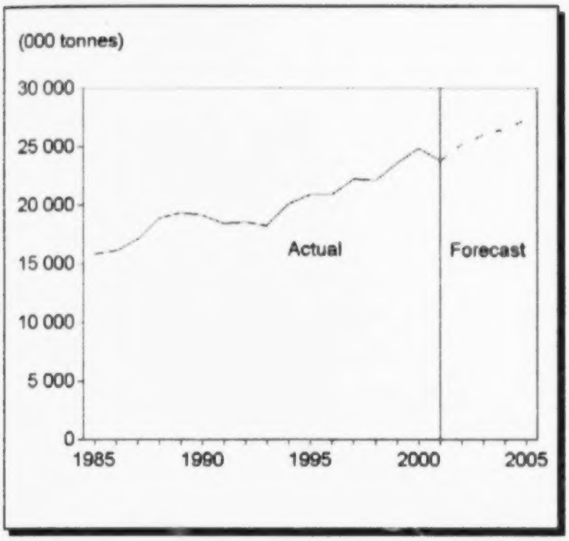
Sources: Natural Resources Canada; London Metal Exchange; Reuters; Metalprices.com.

Figure 11
Alumina Production, 2001 and 2002 (e)
Top Ten Producers - 80% of Total Production of 55.7 Mt in 2002



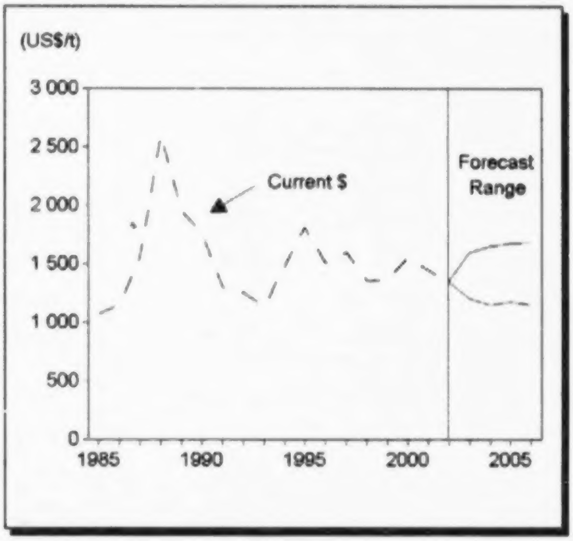
Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; International Aluminum Institute.
(e) Estimate.

Figure 12
World Primary Aluminum Demand, 1985-2005



Sources: Natural Resources Canada; World Nonferrous Metal Statistics Group.

Figure 13
Aluminum Settlement Prices, 1985-2006



Source: Natural Resources Canada.

REFERENCES

[1] In the classification of export statistics, Harmonized System Chapter 76 includes codes for identifiable aluminum products including primary metal, semi-fabricated products and products made of aluminum. See Table 1 for a listing of the main codes. Export data can be obtained at http://strategis.gc.ca/sc_mrkti/tdst/engdoc/tr_homep.html or from Statistics Canada at www.statcan.ca/trade/scripts/trade_search.cgi.

[2] NRCan Canadian aluminum use data for 2001 are from survey-based responses from 185 Canadian companies using primary and recycled aluminum in scrap, ingot or liquid metal form. Scrap used in the production of recycled ingot is not included in "use."

[3] Emissions from aluminum smelters include greenhouse gases other than CO_2 each with different amounts of global warming potential. CO_2 equivalents are calculated taking those factors into account.

[4] Capacity creep results from incremental expansion from removing bottlenecks in existing plants.

[5] Aluminum is different from some other metals in that it is refined before it is smelted.

[6] In a tolling agreement, a plant processes material owned by others for a fee.

[7] The report indicates that, in Canada, cans ranged in weight from 14 grams to 36 grams, with an average of 26 grams.

Notes: (1) Most information in this review was current as of March 31, 2003. (2) Lorraine Ralph of the Minerals and Mining Statistics Division prepared Tables 1, 3a and 3b, and she and others in that Division have provided assistance in generating the summary tables on Canadian aluminum. (3) Various Internet sites have been identified in this article. Please note that Natural Resources Canada has no control over the content of the web sites of other organizations, which may be modified, updated or deleted at any time. (4) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

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TARIFFS

		Canada			United States	EU	Japan
Item No.	Description	MFN	GPT	USA	Canada	MFN	WTO (1)
2606.00.00	Aluminum ores and concentrates	Free	Free	Free	Free	Free	Free
2818.20.00	Aluminum oxide, other than artificial corundum	Free	Free	Free	Free	4%	Free
7601.10	Unwrought aluminum, not alloyed	Free	Free	Free	Free	6%	Free
7601.20	Unwrought aluminum alloys	Free	Free	Free	Free	6%	Free
7602.00	Aluminum waste and scrap	Free	Free	Free	Free	Free	Free
76.03	Aluminum powders and flakes	3.5-5%	Free	Free	Free	5.1-5.3%	3%
76.04	Aluminum bars, rods and profiles	Free-5%	Free	Free	Free	7.5%	7.5%
76.05	Aluminum wire	Free-4%	Free	Free	Free	7.5%	7.5%
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	Free-6.5%	Free-5%	Free	Free	7.5%	Free-2%
76.07	Aluminum foil not exceeding 0.2 mm	Free-6.5%	Free-5%	Free	Free	7.5-10%	7.5%
76.08	Aluminum tubes and pipes	Free-5%	Free	Free	Free	Free-7.5%	7.5%
7609.00	Aluminum tube or pipe fittings	5.5%	3%	Free	Free	7%	3%
76.10	Aluminum structures (excluding prefabricated buildings of heading no. 94.06) and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	6.5%	5%	Free	Free	6-7%	Free-3%
7611.00	Aluminum reservoirs, tanks, vats and similar containers, for any material	Free-6.5%	Free-5%	Free	Free	6%	3%
76.12	Aluminum casks, drums, cans, boxes and similar containers, for any material, of a capacity not exceeding 300 litres	6.5%	2.5-5%	Free	Free	6%	3%
7613.00	Aluminum containers for compressed or liquefied gas	6.5%	5%	Free	Free	6%	3%
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	4.5%	3%	Free	Free	6%	3%
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	6.5%	Free-5%	Free	Free	6%	Free
76.16	Other articles of aluminum	Free-6.5%	Free-5%	Free	Free	6%	3%

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002); *Customs Tariff Schedules of Japan*, 2003.
(1) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADIAN ALUMINUM PRODUCED AND TRADED, 2001 AND 2002

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION		2 582 746	. .	2 708 910	. .
IMPORTS					
2606.00	Aluminum ores and concentrates				
	Brazil	1 496 401	56 860	1 112 748	56 488
	Guinea	478 332	23 511	836 187	40 488
	Ghana	281 805	10 594	514 483	19 581
	Australia	79 648	2 820	234 375	7 330
	United States	67 937	5 208	37 467	5 226
	Bermuda	67 000	1 451	6 680	1 482
	Guyana	222 501	8 343	16 193	1 145
	Greece	12 484	800	18 280	773
	China	25 665	2 615	2 722	404
	Other countries	129 855	6 549	1 051	147
	Total	2 861 628	118 751	2 780 186	133 064
2620.40	Ash and residues containing mainly aluminum	5 747	5 013	6 204	5 449
2818.20	Aluminum oxide (excluding artificial corundum)				
	Australia	1 671 455	478 407	1 877 625	488 043
	United States	1 202 861	358 791	1 215 765	317 396
	Jamaica	1 019 870	286 859	810 324	236 279
	Brazil	681	549	65 809	24 186
	Suriname	–	–	33 409	7 898
	Venezuela	51 921	14 688	26 172	6 898
	Germany	2 136	4 215	7 666	5 324
	China	11 356	7 124	7 112	2 448
	Austria	2 254	2 316	1 831	1 183
	France	1 524	1 856	737	917
	Other countries	7 653	5 594	2 500	2 141
	Total	3 971 713	1 160 399	4 048 950	1 092 713
2818.30	Aluminum hydroxide	5 451	7 306	5 650	6 465
7601.10	Unwrought aluminum, not alloyed				
	United States	21 054	47 647	23 702	56 214
	Australia	62	141	430	1 031
	France	–	–	55	169
	Other countries	438	1 204	59	98
	Total	21 554	48 992	24 246	57 512
7601.20	Unwrought aluminum, alloyed				
	United States	193 009	339 093	163 885	315 544
	Russia	5 245	10 305	4 148	9 514
	United Kingdom	647	1 402	905	2 108
	Canada	53	186	342	1 487
	United Arab Emirates	1 313	3 395	460	1 157
	Netherlands	240	520	558	1 142
	Germany	33	70	325	739
	Other countries	1 835	4 232	1 213	2 648
	Total	202 375	359 203	171 836	334 339
7602.00	Aluminum waste and scrap	114 179	158 358	137 872	197 560
76.03	Aluminum powders and flakes	2 069	8 591	1 937	8 210
76.04	Aluminum bars, rods and profiles				
7604.10	Of aluminum, not alloyed				
	United States	4 611	25 479	4 111	23 527
	Belgium	772	4 097	1 067	5 824
	China	102	377	1 238	4 520
	Canada	209	1 383	274	1 856
	Austria	343	1 335	286	727
	Other countries	509	2 348	429	2 049
	Total	6 546	35 019	7 405	38 303

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7604.21	Of aluminum alloys				
to 7604.29	United States	25 897	131 879	25 975	129 195
	China	5 216	19 530	5 119	21 006
	South Korea	1 847	6 481	2 099	7 546
	Germany	254	1 870	234	1 728
	France	312	1 648	219	1 291
	Italy	122	669	143	1 048
	Russia	180	826	225	990
	United Kingdom	280	1 976	154	973
	Other countries	522	3 065	560	3 107
	Total	34 630	167 944	34 728	166 884
76.05	Aluminum wire	8 466	33 686	10 354	37 447
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	444 096	1 595 642	462 800	1 677 951
76.07	Aluminum foil not exceeding 0.2 mm	48 630	237 924	53 134	262 489
76.08	Aluminum tubes and pipes	12 285	62 425	14 138	73 812
76.09	Aluminum tube or pipe fittings	9 084	61 030	7 016	46 628
76.10	Aluminum structures and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	. .	104 160	. .	121 327
		(number)		**(number)**	
76.11	Aluminum reservoirs, tanks, vats and similar containers, for any material, of a capacity exceeding 300 litres	2 300	35 376	511	1 562
76.12	Aluminum casks, drums, cans, boxes and similar containers, for any material, of a capacity not exceeding 300 litres	1 104 243 318	192 332	1 439 261 603	253 447
76.13	Aluminum containers for compressed or liquefied gas	99 888	10 129	104 146	22 126
		(tonnes)		**(tonnes)**	
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	632	2 394	887	3 395
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	. .	89 032	. .	99 629
76.16	Other articles of aluminum	. .	287 289	. .	297 559
EXPORTS					
2606.00	Aluminum ores and concentrates				
	United States	20	14	–	–
	Cuba	6	5	–	–
	Total	26	19	–	–

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
2620.4	Ash and residues containing mainly aluminum				
	United States	17 425	11 094	48 515	27 904
	Sweden	–	–	166	78
	Switzerland	1 436	653	155	73
	Other countries	1 265	602	41	41
	Total	20 126	12 349	48 877	28 096
2818.20	Aluminum oxide (excluding artificial corundum)				
	United States	47 223	43 584	51 432	48 529
	Israel	64	106	63	62
	Other countries	1 282	2 184	28	33
	Total	48 569	45 874	51 523	48 624
7601.10	Unwrought aluminum, not alloyed				
	United States	934 170	2 169 494	629 027	1 404 015
	Netherlands	133 784	283 027	187 611	392 573
	South Korea	40 417	103 001	45 516	107 837
	Germany	15	178	37 505	83 103
	Mexico	10 677	24 832	35 458	80 558
	France	24 817	51 864	21 346	45 216
	Japan	22 357	46 413	15 771	37 456
	Other countries	5 521	13 929	35 383	76 889
	Total	1 171 758	2 692 738	1 007 617	2 227 647
7601.20	Unwrought aluminum alloys				
	United States	756 106	1 935 398	984 087	2 376 646
	Japan	86 628	201 615	79 915	194 210
	Mexico	17 727	28 556	29 960	55 652
	South Korea	18 207	47 465	14 517	35 616
	United Kingdom	5 629	16 104	4 950	13 721
	Israel	1 081	2 686	3 414	8 337
	Hong Kong	25	85	2 207	5 288
	Ireland	1 379	3 897	1 652	4 243
	Other countries	4 479	11 734	4 861	15 359
	Total	891 261	2 247 540	1 125 563	2 709 072
7602.00	Aluminum waste and scrap				
	United States	267 557	467 709	266 776	446 007
	China	9 147	13 101	17 814	24 509
	Japan	6 476	14 817	3 654	7 620
	Taiwan	1 300	1 582	1 158	1 899
	South Korea	744	1 081	872	1 423
	United Kingdom	–	–	189	367
	Other countries	2 408	3 331	428	548
	Total	287 632	501 621	290 891	482 373
76.03	Aluminum powders and flakes	804	1 864	126	627
76.04	Aluminum bars, rods and profiles	73 526	358 800	88 697	413 789
76.05	Aluminum wire	86 627	229 601	116 364	296 815
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	327 258	1 044 309	364 985	1 120 497
76.07	Aluminum foil not exceeding 0.2 mm	42 033	223 171	51 318	270 259
76.08	Aluminum tubes and pipes	5 484	30 254	4 495	28 858
76.09	Aluminum tube or pipe fittings	. .	11 445	919	10 499

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
76.10	Aluminum structures and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	. .	346 972	. .	380 953
		(number)		**(number)**	
76.11	Aluminum reservoirs, tanks, vats and similar containers, for any material, of a capacity exceeding 300 litres	230	1 613	426	881
76.12	Aluminum casks, drums, cans, boxes and similar containers, for any material	551 513 302	100 565	580 168 555	102 882
76.13	Aluminum containers for compressed or liquefied gas	730 529	3 677	633 156	2 470
		(tonnes)		**(tonnes)**	
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	9 826	36 224	14 372	47 642
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	. .	71 326	. .	63 729
76.16	Other articles of aluminum	. .	200 101	. .	208 998

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; (p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, ALUMINUM SMELTER CAPACITY

Company	As of December 31, 2002 (t/y)
Alcan Aluminium Inc.	
Quebec	
Grande-Baie	196 000
Arvida, Jonquière	248 000
Alma	400 000
Shawinigan	91 000
Beauharnois	50 000
Laterrière	219 000
British Columbia	
Kitimat	275 000
Alcoa Inc.	
Quebec	
Baie-Comeau	
Aluminerie de Baie-Comeau	437 000
Deschambault	
Aluminerie Lauralco Inc.	240 000
Aluminerie de Bécancour Inc.	
Quebec	
Bécancour	390 000
Alcoa, 74.95%	
Pechiney, 25.05%	
Aluminerie Alouette Inc.	
Quebec	
Sept-Îles	244 000
Alcan, 40%	
Aluminium Austria Metall Québec, 20%	
Hydro Aluminium, 20%	
Société Générale de Financement du Québec, 13.33%	
Marubeni Québec Inc., 6.66%	
Total Canadian capacity	2 790 000
Total Alcan, 56.51%	1 576 000
Total Alcoa, 34.74%	969 305
Total other, 8.75%	244 095

Source: Natural Resources Canada.

TABLE 3a. USE[1] OF ALUMINUM METAL[4] IN CANADA AT FIRST PROCESSING STAGE, 1999-2001

	1999 (r,a)	2000 (a,5)	2001 (p,a,6)
		(tonnes)	
METAL USED IN CASTINGS			
Permanent mould	129 574	(r) 132 891	100 420
Sand	4 442	4 460	4 372
Die and other	205 781	(r) 205 031	181 109
Total	339 797	(r) 342 383	285 900
METAL USED IN WROUGHT PRODUCTS			
Sheet, plate, coil and foil	229 139	(r) 214 775	223 864
Extrusions, including tubing	234 843	230 063	217 562
Other wrought products (including rods, forgings and slugs)	153 936	(r) 184 392	179 212
Total	617 918	(r) 629 229	620 638
METAL USED IN OTHER PRODUCTS			
Destructive uses (deoxidizer), non-aluminum base alloys, powder and paste and other uses	41 526	(r) 41 204	38 789
Total used	999 242	(r) 1 012 816	945 336
Aluminum metal used for the production of recycled aluminum (2)	145 959	(r) 159 419	190 893

	Metal Entering Plant			On Hand at December 31		
	1999	2000	2001 (p)	1999	2000	2001 (p)
Primary aluminum and alloys	733 569	(r) 733 232	747 437	21 340	(r) 17 476	15 657
Recycled aluminum	198 370	(r) 191 326	134 800	5 415	(r) 6 672	5 652
Scrap originating outside plant	253 985	(r) 279 190	289 455	13 833	(r) 13 971	13 037
Total	1 185 925	(r) 1 203 748	1 171 693	40 588	(r) 38 120	34 347
Aluminum shipments (3)				33 674	34 525	42 295

Source: Natural Resources Canada.

(r) Revised; (p) Preliminary.

(a) Increase in number of companies being surveyed; therefore, the closing inventory of the previous year does not equal the opening inventory of the current year.

(1) Available data as reported by users. (2) Aluminum metal used in the production of recycled aluminum is not included in usage totals. (3) Aluminum metal shipped without change. Does not refer to shipments of goods of own manufacture. (4) Aluminum metal refers to primary aluminum and alloys, purchased recycled aluminum, and outside aluminum scrap. (5) For 2001 this table is compiled from Natural Resources Canada's annual survey, "Use of Aluminum Metal" from data for 185 Canadian users. (6) Some totals prior to 2001 contained runaround aluminum scrap. In 2001 runaround scrap was removed where known from totals.

Note: Numbers may not add to totals due to rounding.

TABLE 3b. USE[1] OF ALUMINUM METAL[2] IN CANADA, BY TYPE AT FIRST PROCESSING STAGE, 1989-2001

	1989 (a)	1990 (a)	1991 (a)	1992 (a)	1993 (a)	1994 (a)	1995	1996 (a)	1997 (a)	1998 (a)	1999 (a)	2000 (a,4)	2001 (p,a,5)
							(tonnes)						
TYPE OF ALUMINUM METAL USED IN PRODUCTS OTHER THAN RECYCLED ALUMINUM													
Primary aluminum and alloys	393 027	351 877	355 010	369 185	447 997	485 845	490 000	512 865	558 139	653 320	719 124	(r) 722 496	735 931
Purchased recycled aluminum	75 031	82 763	73 461	87 896	95 774	117 710	114 961	119 515	138 852	158 355	199 429	(r) 190 026	134 483
Outside aluminum scrap	27 306	18 617	17 768	24 009	25 084	31 469	30 441	44 555	67 447	78 298	80 689	100 294	74 923
Total used in products other than in recycled aluminum	495 363	453 257	446 239	481 089	568 854	635 024	635 402	676 935	764 438	889 973	999 242	(r) 1 012 816	945 336
TYPE OF ALUMINUM METAL USED IN RECYCLED ALUMINUM (3)													
Primary aluminum and alloys	22 383	x	x	x	x	x	x	x	14 650	x	10 879	13 765	15 423
Outside aluminum scrap	79 716	x	x	x	x	x	x	x	113 865	x	135 081	(r) 145 654	175 470
Total used in recycled aluminum (3)	102 098	115 112	101 503	127 818	131 174	145 661	146 987	81 629	128 515	147 847	145 959	(r) 159 419	190 893

Source: Natural Resources Canada.
(p) Preliminary; (r) Revised; x Confidential.
(a) Increase in number of companies being surveyed.
(1) Available data as reported by users. (2) Aluminum metal refers to primary aluminum and alloys, purchased recycled aluminum, and outside aluminum scrap. (3) Aluminum metal used in recycled aluminum is not included in "Total used in products other than in recycled aluminum" above. (4) For 2001 this table is compiled from Natural Resources Canada's annual survey, "Use of Aluminum Metal" from data for 185 Canadian users. (5) Some totals prior to 2001 contained runaround aluminum scrap. In 2001, runaround scrap was removed where known from totals.
Note: Numbers may not add to totals due to rounding.

TABLE 4. AVERAGE ALUMINUM PRICES

Year	Month	LME Cash Settlement (1)		*Metals Week* U.S. Markets (1)
		(US$/t)	(US$/lb)	(US$/lb)
ANNUAL AVERAGES (2)				
1992		1254.60	0.57	0.58
1993		1139.40	0.52	0.53
1994		1477.20	0.67	0.71
1995		1806.10	0.82	0.86
1996		1506.00	0.68	0.71
1997		1599.70	0.73	0.77
1998		1357.80	0.62	0.66
1999		1361.09	0.62	0.66
2000		1549.14	0.70	0.75
2001		1443.63	0.65	0.69
2002		1349.34	0.61	0.65
MONTHLY AVERAGES				
2001	January	1615.65	0.73	0.75
	February	1604.36	0.73	0.76
	March	1509.17	0.68	0.72
	April	1496.91	0.68	0.71
	May	1538.77	0.70	0.73
	June	1466.13	0.67	0.70
	July	1416.39	0.64	0.68
	August	1377.08	0.62	0.66
	September	1344.56	0.61	0.65
	October	1282.50	0.58	0.62
	November	1327.46	0.60	0.63
	December	1344.63	0.61	0.64
2002	January	1368.59	0.62	0.65
	February	1369.34	0.62	0.64
	March	1405.00	0.64	0.67
	April	1369.99	0.62	0.66
	May	1343.30	0.61	0.66
	June	1353.97	0.61	0.66
	July	1338.09	0.61	0.65
	August	1291.60	0.59	0.63
	September	1304.25	0.59	0.63
	October	1310.58	0.59	0.63
	November	1372.20	0.62	0.66
	December	1375.07	0.62	0.66

Sources: Natural Resources Canada; *Metals Week*.
(1) Highest grade sold. (2) Primary ingots, minimum 99.7% purity.

TABLE 5. AVERAGE ALUMINUM ALLOY (RECYCLED) PRICES

Year	Month	LME Alloy (1) Cash Settlement	
		(US$/t)	(US$/lb)
ANNUAL AVERAGES			
1993		1 005.2	0.46
1994		1 452.9	0.66
1995		1 656.0	0.75
1996		1 302.8	0.59
1997		1 461.0	0.66
1998		1 203.8	0.55
1999		1 191.2	0.54
2000		1 216.9	0.55
2001		1 172.1	0.53
2002		1 234.2	0.56
MONTHLY AVERAGES			
2001	January	1 150.3	0.52
	February	1 258.6	0.57
	March	1 258.0	0.57
	April	1 239.6	0.56
	May	1 233.3	0.56
	June	1 194.2	0.54
	July	1 164.8	0.53
	August	1 164.6	0.53
	September	1 131.9	0.51
	October	1 095.4	0.50
	November	1 087.5	0.49
	December	1 087.4	0.49
2002	January	1 083.30	0.49
	February	1 172.40	0.53
	March	1 248.30	0.57
	April	1 245.80	0.57
	May	1 206.00	0.55
	June	1 235.80	0.56
	July	1 271.00	0.58
	August	1 250.50	0.57
	September	1 235.30	0.56
	October	1 227.50	0.56
	November	1 295.50	0.59
	December	1 335.00	0.61

Sources: Natural Resources Canada; *Metals Week*.

(1) Alloy ingots, meeting LME specifications.

TABLE 6. WORLD MINE PRODUCTION OF BAUXITE, 1996-2001

	World Rank in 2001	1996	1997	1998	1999	2000	2001 (p)
				(000 tonnes)			
Australia	1	43 063.0	44 465.0	44 553.0	48 416.0	53 802.0	53 285.0
Guinea	2	18 282.0	19 250.0	17 000.0	(r) 17 419.1	(r) 17 991.9	17 312.1
Brazil	3	11 060.1	11 162.8	11 961.1	(r) 14 371.5	(r) 14 290.3	13 178.4
Jamaica	4	11 828.6	11 987.3	12 646.4	11 688.5	11 126.5	12 369.6
China	5	8 878.8	9 000.0	6 400.0	7 100.0	7 900.0	7 900.0
India	6	5 757.5	(r) 5 985.0	5 980.1	6 712.2	(r) 7 562.1	7 863.9
Bosnia and Herzegovina	7	–	–	–	–	(r) 2 066.1	7 699.5
Russia	8	3 928.0	(r) 3 988.0	(r) 4 092.0	(r) 4 513.0	(r) 5 000.0	4 805.0
Venezuela	9	4 834.1	4 966.8	4 825.6	4 166.5	4 360.7	4 526.5
Suriname	10	3 702.5	3 877.2	(r) 3 931.1	3 714.6	(r) 3 610.3	4 393.7
Kazakhstan	11	3 345.9	3 416.0	3 436.8	3 606.5	3 729.6	3 685.1
Guyana	12	2 475.5	2 467.3	2 266.7	2 359.3	2 689.5	2 012.7
Greece	13	2 451.7	1 876.6	1 823.0	1 882.5	(r) 1 965.6	1 931.5
Indonesia	14	842.0	808.7	1 055.6	1 116.3	1 150.8	1 237.0
Hungary	15	1 055.8	742.6	1 138.8	941.0	1 046.5	1 000.0
Ghana	16	473.2	519.2	442.5	353.1	424.6	715.5
Yugoslavia	17	323.0	470.0	226.0	500.0	630.0	610.0
Iran	18	230.4	245.0	336.0	(r) 461.6	(r) 440.0	450.0
Turkey	19	544.5	369.5	458.0	207.7	458.5	242.0
United States	20	200.0	200.0	200.0	200.0	200.0	200.0
France	21	165.0	169.0	170.0	170.0	185.0	153.0
Malaysia	22	218.7	279.1	160.3	223.7	123.3	66.1
Vietnam	23	30.0	30.0	30.0	30.0	(r) 16.0	20.0
Mozambique	24	11.5	8.2	6.1	7.9	8.1	8.6
Pakistan	25	4.1	4.9	5.0	11.2	(r) 10.4	3.7
Albania	26	3.4	4.5	4.1	4.6	3.0	3.0
Romania		175.2	127.5	161.9	–	–	–
Total world		123 884.5	(r) 126 420.2	(r) 123 310.1	(r) 130 176.8	(r) 140 790.8	145 671.9
% change from previous year		4.8	2.0	-2.5	5.6	8.2	3.5

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; World Bureau of Metal Statistics, media reports.
– Nil; (p) Preliminary; (r) Revised.

TABLE 7. PRODUCTION OF ALUMINA (HYDRATE), 1997-2002

	World Rank in 2001	World Rank in 2002	1997	1998	1999	2000	2001	2002 (e)
					(000 tonnes)			
Australia	1	1	(r) 13 384.0	13 853.0	14 532.0	(r) 15 037.0	16 271.0	16 390
China	2	2	2 922.8	3 340.0	3 822.0	(r) 4 326.7	4 729.1	54 440
United States (3)	3	3	5 093.0	5 654.0	5 144.0	(r) 4 786.0	4 340.0	4 500
Jamaica	4	4	3 394.2	3 440.2	3 569.6	3 600.1	3 542.4	3 650
Brazil	5	5	3 088.0	3 322.1	3 515.1	(r) 3 751.0	3 519.7	3 650
Russia	6	6	2 379.8	2 465.4	2 657.1	(r) 2 856.0	3 048.0	3 200
India	7	7	1 940.0	1 855.0	1 930.0	2 107.0	2 170.0	2 600
Venezuela	9	8	1 730.4	1 553.4	(r) 1 469.0	1 755.3	1 833.2	2 000
Suriname	8	9	1 725.9	1 771.9	1 853.1	1 906.1	1 893.3	1 900
Ireland (1)	10	10	(r) 1 272.9	(r) 1 395.7	(r) 1 95.7	(r) 1 410.7	1 448.7	1 540
Ukraine	11	11	1 074.5	1 290.7	1 230.2	1 360.0	1 340.0	1 350
Spain	13	12	1 110.3	1 110.0	1 112.0	1 123.0	1 199.0	1 350
Kazakhstan	12	13	1 094.2	1 084.5	1 157.7	(r) 1 216.7	1 231.1	1 300
Canada (2)	14	14	1 165.0	1 229.0	1 233.0	(r) 1 023.0	1 036.0	1 050
Italy	15	15	914.0	935.0	973.0	1 022.0	993.0	1 010
Germany	16	16	850.0	778.3	806.0	826.0	836.0	850
Japan	17	17	728.0	737.6	736.6	781.7	739.1	775
Greece	18	18	615.7	649.4	633.0	690.0	709.0	750
Guinea	19	19	527.0	500.0	(r) 568.5	541.0	674.3	698
France	20	20	589.0	520.0	556.0	600.0	598.0	610
Yugoslavia	22	21	159.5	(r) 152.5	156.0	186.1	200.7	225
Romania (1)	21	22	279.5	250.2	277.4	416.6	319.4	200
Hungary	23	23	350.0	(r) 138.0	(r) 156.4	(r) 204.3	200.0	200
Turkey	24	24	164.3	156.8	159.1	155.4	185.0	190
Bosnia and Herzegovina	25	25	–	–	(r) 37.0	(r) 219.4	100.0	100
Azerbaijan	27	26	–	–	(r) 76.0	(r) 217.0	95.0	100
United Kingdom	26	27	100.0	115.0	94.0	89.0	98.0	85
Slovakia			46.8	–	–	–	–	–
South Korea			70.0	–	–	–	–	–
Total world			(r) 46 768.8	(r) 48 224.5	(r) 49 849.5	(r) 52 207.1	53 349.0	55 713.00
% change from previous year			4.5	3.1	3.4	4.7	2.2	4.4

Sources: Natural Resources C ational Consultative Group on Nonferrous Metals Statistics, International Aluminium Association; media reports.
– Nil; (r) Revised.
(1) Calcined. (2) Alumina e lcined equivalent.

TABLE 8. WORLD PRODUCTION OF PRIMARY ALUMINUM, 1997-2003

	World Rank in 2001	World Rank in 2002	1997	1998	1999	2000	2001	2002 (e)	2003 (f)
					(000 tonnes)				
China	1	1	2 035.0	2 335.7	2 598.5	(r) 2 794.1	3 424.6	4 270.0	5 100.0
Russia	2	2	2 906.0	(r) 3 010.0	3 149.0	3 247.0	3 302.0	3 350.0	3 400.0
Canada	4	3	2 327.2	2 374.1	2 389.8	2 373.5	2 582.7	2 710.0	2 730.0
United States	3	4	3 603.4	3 712.7	3 778.6	3 668.4	2 637.0	2 700.0	2 650.0
Australia	5	5	1 490.1	1 626.2	1 719.3	1 761.5	1 784.1	1 850.0	1 875.0
Brazil	6	6	1 189.1	1 208.0	1 249.6	(r) 1 271.4	1 132.0	1 320.0	1 375.0
Norway	7	7	918.6	994.2	1 009.0	1 031.1	1 034.2	1 050.0	1 150.0
India	10	8	544.9	(r) 542.0	594.0	646.3	624.1	690.0	840.0
South Africa	8	9	682.9	692.5	(r) 689.2	(r) 674.2	663.0	676.0	685.0
Germany	9	10	571.9	612.4	633.8	643.5	651.6	650.0	660.0
Venezuela	11	11	(r) 642.0	586.5	(r) 570.3	(r) 570.9	570.6	610.0	620.0
Dubai	12	12	379.2	386.6	440.7	536.0	536.0	540.0	545.0
Bahrain	13	13	489.9	501.3	502.7	509.0	522.1	525.0	530.0
France	14	14	399.4	423.6	455.1	441.2	460.9	460.0	410.0
Spain	15	15	359.9	360.4	363.9	365.7	376.4	380.0	385.0
United Kingdom	16	16	247.7	258.4	272.2	305.1	340.8	345.0	345.0
New Zealand	17	17	310.3	(r) 317.5	326.7	(r) 328.4	322.3	334.0	340.0
Tajikistan	18	18	188.9	195.6	229.1	(r) 300.0	324.0	325.0	325.0
Netherlands	19	19	231.8	(r) 264.7	287.4	301.7	293.2	295.0	295.0
Mozambique	21	20	–	–	–	(r) 63.8	270.2	270.0	300.0
Argentina	20	21	187.2	186.7	206.4	261.8	245.1	265.0	265.0
Iceland	22	22	122.9	173.4	221.5	225.7	242.6	265.0	275.0
Egypt	25	23	178.2	187.2	186.7	188.9	190.8	195.0	195.0
Italy	24	24	187.7	187.0	187.2	189.2	187.4	190.0	190.0
Romania	26	25	161.9	174.0	174.1	179.0	179.8	185.0	200.0
Indonesia	23	26	(r) 217.4	(r) 134.3	(r) 112.3	(r) 192.3	208.8	160.0	180.0
Greece	27	27	132.6	146.1	159.9	162.6	162.0	160.0	160.0
Iran	29	28	(r) 91.0	(r) 111.0	(r) 138.0	139.5	145.2	160.0	160.0
Slovakia	30	29	110.2	108.0	109.2	109.8	122.0	144.0	150.0
Yugoslavia	35	30	(r) 80.6	(r) 76.7	(r) 80.9	(r) 95.5	108.1	116.0	118.0
Ukraine	31	31	100.5	106.7	112.4	103.6	106.1	112.0	112.0
Ghana	28	32	151.6	56.1	114.2	155.5	162.3	100.0	50.0
Sweden	32	33	98.4	95.7	98.5	100.1	101.8	100.0	100.0
Bosnia	34	34	8.0	(r) 38.0	70.0	94.5	95.6	100.0	100.0
Slovenia	36	35	74.4	70.8	77.2	(r) 75.6	76.6	90.0	125.0
Cameroon	33	36	90.9	81.6	91.9	94.9	80.5	70.0	70.0
Turkey	38	37	62.0	61.8	61.7	61.5	61.7	60.0	60.0
Poland	39	38	51.5	51.5	51.6	(r) 55.5	54.6	50.0	50.0
Mexico	37	39	66.4	61.8	62.7	(r) 61.2	51.5	50.0	50.0
Switzerland	40	40	27.3	32.1	34.4	35.5	36.2	36.0	36.0
Hungary	41	41	32.5	33.7	33.6	33.9	34.6	35.0	35.0
Japan	42	42	16.7	16.3	10.9	6.5	6.6	7.0	7.0
Suriname			23.1	27.1	6.6	–	–	–	–
Azerbaijan			–	–	–	–	–	–	–
Nigeria			2.5	25.5	15.9	–	–	–	–
Total world			(r) 21 793.7	(r) 22 645.5	(r) 23 676.7	(r) 24 455.4	24 511.7	25 999.9	27 248.0
% change from previous year			4.5	3.9	4.6	3.3	0.2	6.1	4.8

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; World Bureau of Metal Statistics; International Aluminium Institute; media reports.

– Nil; (e) Estimated; (f) Forecast; (r) Revised.

TABLE 9. APPARENT USE OF PRIMARY ALUMINUM, 1997-2001

	World Rank in 2001	1997	1998	1999	2000	2001
				(000 tonnes)		
Albania	76	1.0	1.0	1.0	1.0	1.0
Algeria	69	5.0	5.0	4.1	(r) 4.1	4.1
Argentina	38	94.9	106.3	82.9	(r) 80.2	70.6
Australia	16	352.0	370.3	344.4	350.5	320.0
Austria	22	162.0	159.8	142.6	168.2	201.0
Bahrain	17	(r) 191.1	(r) 200.3	(r) 226.2	(r) 239.2	261.0
Bangladesh	57	14.2	17.8	18.0	18.0	18.0
Belarus	64	7.4	9.1	9.0	9.0	9.0
Belgium	14	345.0	370.0	350.0	341.0	345.0
Brazil	12	478.6	521.4	463.1	513.7	552.8
Bulgaria	65	7.8	8.0	8.0	8.6	8.1
Cameroon	53	24.7	24.9	22.0	24.8	24.0
Canada	9	643.5	720.6	777.2	(r) 799.5	759.6
Chile	60	15.5	(r) 14.6	11.2	(r) 14.5	14.5
China (1)	2	2 289.0	2 421.0	2 914.0	(r) 3320	3 450.0
Colombia	49	42.8	36.3	27.4	(r) 32.1	30.0
Croatia	44	22.0	24.0	(r) 29.5	28.4	37.1
Cuba	77	1.0	1.0	1.0	1.0	1.0
Czech Republic	37	62.8	78.9	65.7	77.6	88.3
Denmark	41	36.0	38.9	39.4	41.2	44.0
Dubai	54	32.1	18.5	20.0	(r) 17.9	20.0
Egypt	34	97.9	91.6	82.7	81.8	96.5
Finland	45	33.1	36.2	37.1	38.5	36.9
France	7	724.2	733.8	774.2	(r) 781.4	760.9
Germany	4	1 558.0	1 520.0	1 446.0	(r) 1542	1 550.0
Ghana	58	16.0	16.0	16.0	16.0	16.0
Greece	21	203.8	212.7	212.5	(r) 230	217.5
Hungary	20	183.4	163.7	171.3	210.1	222.7
Iceland	70	1.7	3.0	3.0	3.0	3.0
India	10	553.4	566.5	569.5	602.4	589.2
Indonesia	26	203.0	75.4	138.7	145.8	162.9
Iran	30	(r) 103.9	(r) 103.1	(r) 123.2	(r) 116.8	120.0
Iraq	78	1.0	1.0	1.0	1.0	1.0
Ireland	66	5.8	6.6	8.2	10.2	7.8
Israel	43	39.5	45.9	44.0	44.8	38.0
Italy	8	671.0	674.0	734.6	(r) 762	760.0
Japan	3	2 433.5	2 082.0	2 112.3	(r) 2224.9	2 014.0
Kazakhstan	73	1.6	1.7	2.0	2.0	2.0
Lebanon	59	17.0	20.9	14.2	(r) 16	15.6
Macedonia	74	(r) 5	(r) 5.6	(r) 2.5	(r) 2.4	1.8
Malaysia	36	147.8	64.7	130.6	115.0	92.2
Mexico	32	63.2	91.1	89.6	(r) 101.5	114.0
Morocco	68	2.0	(r) 3.7	3.5	5.7	5.7
Netherlands	29	155.0	155.0	155.0	155.0	155.0
New Zealand	46	37.0	34.2	42.8	42.7	35.6
Nigeria	67	7.0	7.0	7.0	7.0	7.0
North Korea	55	20.0	20.0	20.0	20.0	20.0
Norway	18	197.0	165.0	217.0	(r) 231	240.0
Other Africa	62	12.0	10.0	12.0	12.0	12.0
Other America	51	25.0	25.0	25.0	25.0	25.0
Other Asia	42	35.0	30.0	35.0	(r) 35	40.0
Other Europe	72	2.0	1.5	2.0	(r) 2	2.0
Pakistan	63	15.0	15.0	9.4	10.0	10.0
Peru	75	2.5	2.5	0.9	1.3	1.1
Philippines	50	34.2	24.0	33.6	32.8	25.2
Poland	28	101.5	107.8	133.0	149.9	159.2
Portugal	39	75.4	68.3	82.0	78.0	66.9
Romania	33	70.6	87.7	113.6	125.7	112.5
Russia	6	(r) 469.2	489.2	(r) 562.8	748.4	786.2
Saudi Arabia	52	25.0	25.0	25.0	25.0	25.0
Singapore	61	15.0	33.5	4.3	4.1	13.6
Slovakia	47	4.6	22.2	(r) 34.1	(r) 36.4	34.9
Slovenia	35	(r) 51.8	74.6	(r) 75.5	(r) 81.7	98.1
South Africa, Rep. of	23	124.4	142.8	125.0	(r) 186.3	198.2
South Korea	5	666.3	505.7	813.9	(r) 822.5	849.6
Spain	13	430.0	435.5	494.0	525.6	507.8
Sweden	31	142.0	177.0	(r) 133	147.0	118.6
Switzerland	27	144.0	165.9	157.0	(r) 165	161.2
Taiwan	15	374.3	300.7	464.1	501.6	321.3

TABLE 9 (cont'd)

	World Rank in 2001	1997	1998	1999	2000	2001
				(000 tonnes)		
Thailand	19	232.8	128.4	155.3	195.2	227.0
Tunisia	71	2.1	4.4	2.6	3.0	3.0
Turkey	24	160.8	180.7	169.4	211.2	175.7
United States	1	5 800.0	6 100.0	(r) 6372	(r) 6275	5 420.0
Ukraine	40	50.0	50.0	50.0	50.0	50.0
United Kingdom	11	583.0	579.0	581.0	588.0	560.0
Venezuela	25	193.4	(r) 208.2	(r) 154.8	(r) 183.4	164.7
Vietnam	48	8.4	15.6	(r) 17.6	(r) 20.3	30.9
Yugoslavia	56	23.7	19.2	13.4	16.0	18.7
World Total		(r) 22 204.2	(r) 22 065.5	(r) 23 566.2	(r) 24 856.9	23 760.8
% change from previous year		6.6	-0.6	6.8	5.5	-4.4

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.
(r) Revised.
(1) Starting in 1997, Hong Kong is included with China.

TABLE 10. ABBREVIATIONS OF COMPANY NAMES AND INSTITUTIONS USED IN THIS REPORT

Company	Abbreviation	Web Site Address
Alcan Inc.	Alcan	www.alcan.com
Alcoa Inc.	Alcoa	www.alcoa.com
Alcoa World Alumina and Chemicals	AWAC	www.alcoa.com
Alumina do Norte do Brasil S.A.	Alunorte	www.vale.com.br
Aluminerie Alouette Inc.	Alouette	www.alouette.qc.ca
Aluminerie de Bécancour Inc.	A.B.I.	www.alcoa.com
Aluminium Association of Canada	The Association	www.aia.aluminium.qc.ca
Aluminium Corp. of China	Chalco	. .
Alumina Partners of Jamaica	Alpart	www.kaiseral.com
Cambior Inc.	Cambior	www.cambior.com
Columbia Ventures Corporation	Columbia Ventures	www.nordural.is
Comalco Ltd.	Comalco	www.riotinto.com
CVG Alcasa	Alcasa	www.aluminio.com.ve
Dubai Aluminium Company Limited	Dubal	www.dubal.co.ae
Aluminum Company of Egypt	Egyptalum	www.egyptalum.com.eg
Elkem ASA	Elkem	www.elkem.com
Federation of Aluminium Consumers in Europe	FACE	www.facealuminium.com
Hindalco Industries Limited	Hindalco	www.adityabirla.com
International Aluminium Institute	IAI	www.world-aluminium.org
KTD L.L.C.	KTD	www.k[illegible]al.com
Minmetals Nonferrous Metals Co., Ltd.	Minmetals	www.minmetals.com
National Aluminium Company Limited	Nalco	www.nalcoindia.com
Norsk Hydro A.S.A / Hydro Aluminium a.s.	Norsk Hydro or Hydro Aluminium	www.hydro.com
Pechiney SA	Pechiney	www.aluminium-pechiney.com
Russian Aluminium (Russky Aluminii)	Rusal	www.rusal.com
Sibirsky Aluminium	Sibirsky (Russian Aluminum)	www.sibirskyaluminum.com
Société Générale de financement du québec	SGF	www.sgfqc.com
Tomago Aluminium Pty Ltd	Tomago	www.tomago.com.au
The Aluminum Association Inc.	Aluminum Association	www.aluminum.org
Vietnam National Mineral Corp.	Vimico	. .

Source: Natural Resources Canada.
. . URL not available.

TABLE 11. BAUXITE AND ALUMINA PROJECTS

Country	Project/Company	Remarks	Near-Term Change (t/y)
Australia	Pechiney, SA	Studies for potential 1.5-Mt/y refinery with associated mine on Cape York Peninsula.	
	Gladstone alumina refinery - Comalco	First stage of proposed A$1.4 billion refinery in central Queensland under construction; production expected in late 2004. Requires expansion of the Weipa bauxite mine proposed to 16 Mt/y from 11.5 Mt/y. Potential to increase refinery capacity to 4 Mt/y.	1 400 000
	Gove alumina refinery - Alcan	Proposed expansion of refinery from 2 Mt/y to 3.5 Mt/y. Engineering studies in 2003 with environmental approvals expected in 2004; construction expected to take three years.	
	Queensland Alumina Ltd. refinery	Potential to expand capacity from 3650 t/y to 4350 t/y.	
	WMC Limited	Aluminum interests transferred to new operating company.	
	Wagerup - Alcoa/WMC	Decision pending on increase in capacity of refinery.	
	Pinjarra - Alcoa	Government approvals pending on increase in capacity of refinery to 4 Mt/y from 3.4 Mt/y.	
	Worsley	Expansion of refinery to 3.7 Mt/y from 3.1 Mt/y expected by 2008.	
Azerbaijan	Sumgait nonferrous metals plant	Expansion of alumina refinery from 300 000 t/y to 450 000 t/y.	150 000
Brazil	Barcarena alumina refinery - Alunorte CVRD and Norsk Hydro	Expansion completed from 1.5 to 2.3 Mt/y in late 2002. Feasibility study on further expansion to 5 Mt/y. Studies for a new bauxite mine to support additional expansions.	800 000
	Alunorte refinery CVRD	Expansion to 800 000 t/y expected to be completed in early 2003; studies under way for further expansion.	
	Para State mine - CVRD	Studies under way for potential new 5-Mt/y mine in 2005.	
	Trombetas mine - Mineracao Rio do Norte	Expansion of mine to support Alunorte and Alumar alumina refinery expansions expected to be completed in late 2002. Production at capacity dependent on markets.	5 200 000
China	Baise Yinhai - Pechiney and Minmetals	Discussions on possible new 400 000-t/y alumina refinery in Guangxi, with later expansion potential to 2 Mt/y.	
	Denfeng Aluminium Plant	Plans postponed for a new 100 000-t/y refinery.	
	Guangxi Guixi Huayin Aluminium Corp - Chalco/MinMetals	Feasibility studies for new 800 000-t/y refinery in Guangxi region. Construction could start in late 2003.	800 000
	Guizhou refinery - Chalco	Expansion by 300 000 t/y expected to be completed by end of 2003.	300 000
	Guizhou - Zunyi Aluminum	Plans for new 300 000-t/y refinery.	
	Huanghe Aluminium and Power Group	Plans to start up new 100 000-t/y refinery in 2003. Potential expansion to 500 000 t/y.	
	Henan Dengfeng Aluminium Industry Co. Ltd	Delayed plans for construction of 100 000-t/y alumina refinery to feed its planned smelter expansion.	
	Pingguo refinery joint venture with Alcoa - Chalco	Joint venture delayed. Construction to finish in 2003 for doubling the capacity of refinery to 850 000 t/y.	400 000
	Pingguo bauxite mine	New 1.1-Mt/y mine start-up expected in June to take mining capacity to 2 Mt/y.	250 000
	Shanxi - Chalco	Potential new 800 000-t/y alumina refinery with Shandong Electric Power. Co.	
	Zhongzhou refinery - Chalco	Expansion by 300 000-t/y expected to be completed by end of 2003.	300 000
Guinea	Dian-Dian - Russian Aluminium	Government approval of bauxite mine and refinery. Port and rail facilities to be constructed. Proposed capacity up to 11 Mt/y of bauxite and 1.2 Mt/y of alumina. Potental 240 000-t/y smelter.	
	Guinea Aluminium Products Co. (Gapco)	Discussions on expansion of Friguia alumina plant by 350 000 t/y, hydro dam and 240 000-t/y smelter. Possible new 2.6-Mt/y refinery.	
Guyana	Linden Mining Enterprises	Government in discussions with Cambior to manage its bauxite mine. Government wishes to construct new 600 000-t/y refinery.	
India	Gujarata Alumina Bauxite Ltd.	Proposal for 750 000-t/y refinery in Gujarat. Production would not start until after 2005.	
	Korba - Bharat Aluminium	Expansion of refinery from 180 000 t/y to 830 000 t/y approved. Project expected to be completed in 2005.	
	Renukoot - Hindalco	Expansion and debottlenecking of refinery under way from 450 000 t/y to 700 000 t/y. Completion expected in 2003.	250 000
	Pechiney, SA	Interested in constructing a 1-Mt/y alumina refinery in Orissa, India; feasibility study under way; decision expected in 2003.	
	Korba - Bharat Aluminium	Possible expansion of refinery from 180 000 t/y to 800 000 t/y by 2005.	

TABLE 11 (cont'd)

Country	Project/Company	Remarks	Near-Term Change
			(t/y)
	Utkal - Alcan, Hindalco	Bauxite mine and alumina refinery in Orissa. Initial refinery capacity of 1.5 Mt/y; second stage to 3 Mt/y. Construction planned for 2003 may be delayed.	
Jamaica	Alumina Partners of Jamaica - Kaiser and Hydro Aluminium	Expansion of Alpart refinery from 1.45 Mt/y to 1.65 Mt/y in 2003.	200 000
	Clarendon refinery - Alcoa and Jamalco	Agreement reached on 250 000-t/y expansion of Woodside refinery by 2004.	250 000
Russia	Timan bauxite mine - Sual Group	Mine at Sredne-Timan in Komi Republic under development. Expected capacity to eventually reach 3 Mt/y of bauxite. Plans production of 950 000 t in 2003. Possible new 1.4-Mt/y refinery and smelter to be associated with mine. Rail line completed. Hatch and Associates awarded contract for prefeasibility and engineering work on alumina refinery and smelter. Cooperation agreement with Pechiney in early 2003.	750 000
Suriname	Suralco refinery - Alcoa/BHP Billiton	Agreement signed on expansion of refinery by 250 000 t/y to 2 Mt/y.	250 000
United Kingdom	Scotland - Bruntsland Refinery - Alcan	Closure of 120 000-t/y chemical-grade alumina refinery in November 2002.	-120 000
United States	Alcoa - Point Comfort	Alumina output to increase in 2003.	300 000
Vietnam	Government of Vietnam	Seeking foreign investors in bauxite and alumina refineries. Plans construction of a 300 000-t/y alumina refinery; production possible in 2006.	
	Dac Nong - China Non-Ferrous Corp./Vimico	Memorandum of Understanding on a new feasibility study for a potential new 1-Mt/y refinery and bauxite mine. Production for export and a possible local 75 000-t/y smelter. Decision expected in early 2003.	
Venezuela	Bauxilum - CVG Bauxilum/Pechiney	Refinery expansion under way to 2.2 Mt/y.	200 000
	Bauxilum - CVG Bauxilum/Pechiney	Potential second-phase expansion of refinery capacity from 2.2 Mt/y to 3 Mt/y.	

Source: Natural Resources Canada, based on published reports.

TABLE 12. SMELTER PROJECTS

Country	Project/Company	Remarks	Near-Term Change Amount
			(t/y)
Australia	Boyne Island - Comalco	Deferred expansion of smelter (by 200 000 t/y).	
	WMC Alumina Limited Limited	Aluminum interests transferred to new operating company.	
	Kurri Kurri smelter	Hydro Aluminium to upgrade smelter. Capacity to increase by 15 000 t/y.	15 000
	Aldoga Consortium	Proposed 560 000-t/y smelter near Gladstone received major project status. Letter of intent with Russian Aluminium on a joint venture feasibility study. Work on feasibility studies. Construction expected to start in 2003; production to start in 2005.	
	Tomago smelter - Tomago Aluminium Pty Ltd.	Partners approved upgrades resulting in 70 000-t/y expansion in capacity to 530 000 t/y. Completion expected in 2006.	
Azerbaijan	Azerbaijan Aluminum	Continued work toward restart of smelter in 2002 with reduced capacity of 30 000 t/y. New smelter proposed with capacity of 150 000-200 000 t/y.	30 000
Brazil	Albras - CVRD	Expanded capacity became operational in early 2002.	46 000
	Sorocoba smelter - Cia Brasileira de Aluminio	Expansion of smelter under way from 230 000 t/y to 340 000 t/y. To be completed in 2003.	110 000
	Cataguazes, Minas Gerais - Cia Brasileira de Aluminio	Proposed new smelter with capacity of 500 000 t/y.	
Bahrain	Aluminum Bahrain	Expansion under way from 520 000 t/y to 820 000 t/y. Construction to start in early 2003.	300 000
	Aluminum Bahrain - Alcoa	Agreement on an additional expansion (200 000 t/y) with Alcoa to bring total capacity to 1 Mt/y by 2005.	
Bosnia	Aluminij Mostar	Plans feasibility study for second potline to expand capacity from 110 000 t/y to 220 000 t/y.	
Canada	Alma smelter - Alcan	To start construction on potlining centre in 2003.	
	Alouette smelter expansion - Alouette Inc.	Expansion approved; completion expected in 2005. Discussed in text.	300 000
	Baie Comeau - Alcoa	Modernization planning under way. Capacity to be raised in longer term by 110 000 t/y. Completion in 2010.	
	Deschambault smelter (Lauralco) - Alcoa	Expansion by 330 000 t/y. Discussed in text.	
Chile	Alumysa proposed smelter - Noranda	Environmental and social studies under way for a proposed US$2.75 billion hydro-electric project and smelter near Puerto Aisen.	

TABLE 12 (cont'd)

Country	Project/Company	Remarks	Near-Term Change Amount
			(t/y)
China	Baiyin aluminum smelter	Expected completion of expansion to 100 000 t/y in 2002 from 72 000 t/y. Expects to expand to 130 000 t/y in 2003.	50 000
	Baotou Aluminium	Construction under way of a 50 000-t/y expansion to 180 000 t/y. Potential modernization with further expansion to 250 000 t/y.	50 000
	Baise Yinhai Aluminium Co.	Delays in start-up of new 50 000-t/y smelter. Planned expansion to 100 000 t/y in 2003.	50 000
	Jiangsu -Datun Gas and Power	Construction of a new 100 000-t/y smelter started in 2002. Phase one to be 50 000 t/y with expected completion in 2003.	50 000
	Fushun Aluminium Company	Replacement smelter started up in late 2002. Capacity now 160 000 t/y. Second phase expansion of 50 000 t/y expected to be completed in 2003.	50 000
	Guangxi - Baise Yinhai Aluminium Co.	Completed construction of new 50 000-t/y smelter in 2002, but delayed metal production to 2003. Plans to double capacity to 100 000 t/y by 2004.	50 000
	Guizhou - Chalco	Expansion of smelter under way to reach 395 000 t/y by 2004.	160 000
	Guizhou - Zunyi aluminum plant	Expansion from 32 000-t/y to 132 000-t/y capacity started in 2001; to be completed in 2003.	100 000
	Henan Dengfeng Aluminium Industry Co. Ltd.	Planned to complete new power generation facilities by 2003 for an eventual expansion of capacity to 100 000 t/y from 40 000 t/y. Seeking funding for smelter expansion.	
	Henan Wanji Aluminium Co.	Completed expansion from 60 000 t/y to 180 000 t/y.	120 000
	Inner Mongolia - East Hope Group	Planning a 1-Mt/y smelter in Baotou. Construction of first phase of 150 000 t/y started in late 2002.	150 000
	Jiaozuo Wanfang Aluminium Co.	Smelter expansion to 180 000 t/y from 110 000 t/y approved and under way. Further expansion expected to 300 000 t/y in 2004.	70 000
	Jiamusi aluminum smelter	Seeking investors for 100 000-t/y expansion.	
	Lanzhou Aluminium Co.	Expansion of capacity by 100 000 t/y. Agreement in principle with Pechiney on technical cooperation and studies to be carried out in 2003 for a proposed 260 000-t/y smelter and associated electrical generation facilities in Gansu province.	100 000
	Lintao aluminum plant	Company expects to modernize and expand smelter located in Gansu from 10 000 t/y to 50 000 t/y in 2003.	40 000
	Nantun Shandong smelter -Yankuang Group	Construction under way of 140 000-t/y smelter; expected to be in operation in 2004.	140 000
	Ningxia Zhongning aluminum smelter	Construction to start on smelter expansion in 2003. Possible expansion to 300 000 t/y.	70 000
	Pingguo - Chalco - joint venture with Alcoa	Waiting for approvals for proposed tripling of capacity of the Pingguo aluminum smelter from 130 000 t/y to 380 000 t/y.	250 000
	Qinghai Qiaotou Aluminum and Electricity Co.	New 150 000-t/y smelter in Qinghai expected to be completed in 2004. Possible second phase to double capacity.	50 000
	Qingtongxia aluminium smelter	Plans to expand existing plant by 150 000 t/y. In 2001, Alcan signed a Memorandum of Understanding on a joint venture to have a 50% interest in the smelter and planned expansion. Discussions are continuing.	150 000
	Shandong Aluminum	Soderberg potline closed.	-35 000
	Rizhao smelter -Yankuang Group	Potential new 400 000-t/y smelter. Work on financing and approvals under way.	
	Shanxi smelter - Chalco/Shanxi Zhangze Electric Power Co.	New 280 000-t/y smelter planned for 2005 in Hejin with new 600-MW power plant. Replaces proposal with Beijing Datang Power Co.	
	Shanxi - Shanxi Guanlu Co. Ltd.	Company started construction of 200 000-t/y expansion of smelter; final capacity of 320 000 t/y. First metal expected in mid-2003.	200 000
	Shijiazhuang Aluminium Co.	Feasibility study for modernization and expansion by 20 000 t/y.	
	Tongchuan Xinguang Aluminium Industry Co.	Modernization to phase out Soderberg pots and expansion under way. Capacity to double from 60 000 t/y to 120 000 t/y.	
	Xinfa Aluminium Co.	Plans to expand Shandong smelter capacity from 100 000 t/y to 420 000 t/y. Possibility for an additional 600 000-t/y smelter.	
	Yangxin aluminium smelter	Expansion of 10 000 t/y to 20 000 t/y.	10 000
	Yichang, Hubei Smelter - Chalco	Letter of intent with partners on a feasibility study for a new 500 000-t/y smelter near Three Gorges Dam. First phase 250 000 t/y construction expected in 2004.	
	Yuci Hengyu Aluminium Industry	Seeking investors for new 100 000-t/y smelter.	
	Yugang Lonquan Aluminium Co. Ltd.	Expanded capacity in 2002 from 55 000 t/y to 200 000 t/y.	145 000
	Yunnan Aluminium - Kunming smelter	Planned modernization of smelter from Soderberg to prebake technology postponed.	

TABLE 12 (cont'd)

Country	Project/Company	Remarks	Near-Term Change Amount (t/y)
China (cont'd)	Zhengzhou Longxian Aluminium Power Co.	Planning for expansion in 2004 to 150 000 t/y from 50 000 t/y.	
	Zhengzhou Shangjie aluminum plant	Planning to increase capacity in 2005 from 26 000 t/y to 100 000 t/y.	
	Zhenxing Group Co.	Completed construction of a 40 000-t/y expansion to total capacity of 60 000 t/y in mid-2002.	20 000
	Zouping Aluminium Co. Ltd.	Doubling capacity to 66 000 t/y by mid-2002. Plans thereafter to boost production to 200 000 t/y.	33 000
Dubai	Dubal	Upgrade approved by government. Work under way to expand capacity from 535 000 t/y to 710 000 t/y.	175 000
Egypt	Egyptalum	Expansion and modernization - progress slower than expected but work now under way. Capacity to be raised by 50 000 t/y by 2004 along with conversion of potline #5 to prebake technology.	50 000
France	Auzat - Pechiney	Smelter closure in early 2003.	-48 000
Ghana	Volta - Kaiser	Two potlines closed due to lack of power in 2002.	-80 000
Guinea	Guinea Aluminium Products Co.	Discussions on possible 240 000-t/y smelter.	
Iceland	Straumsvik - Icelandic Aluminum (ISAL)	Environmental studies for a possible expansion to 460 000 t/y from 160 000 t/y.	
	Fjardaal - Alcoa	Joint Action plan and agreement with Icelandic government on new 322 000-t/y smelter (replaces the Noral project). Construction expected to start in 2005; metal production in 2007.	
	Norðurál - Columbia Venture Corp.	Planning expansion from 90 000 t/y to 180 000 t/y by 2006.	
	Atlantsal Ltd.	Feasibility studies to be completed in 2003 for a proposed 360 000-t/y smelter.	
India	Angul - Nalco	Completed expansion in 2002 to 345 000 t/y from 230 000 t/y.	115 000
	Alupurram- Indian Aluminium	Smelter to be closed.	-14 000
	Renukoot - Hindalco	Expansion by 120 000 t/y to 360 000 t/y expected to be completed in 2003.	120 000
	Korba - Bharat Aluminium	Possible expansion of smelter from 100 000 t/y to 300 000 t/y by 2005. Signed power contract to increase production to 125 000 t/y by 2003.	25 000
	New smelter - Chalco and Kutch Alumina Power and Coke Company Limited	Discussions on possible 120 000-t/y smelter.	
Indonesia	PT Indonesia Asham Aluminium	New power plant to ease current power shortages delayed. Once completed, planning to expand from 225 000 t/y to 300 000 t/y.	
Iran	Iran Aluminium Company	Continued work on proposal for new Arak smelter (110 000 t/y).	
Kazakhstan	Pavlodar - Aluminum of Kazakhstan	Planning for a new 240 000-t/y smelter associated with the Pavlodar alumina refinery.	
Malaysia	Bintulu - Sarawak - Dubal Aluminum	Proposed 500 000-t/y smelter, based on new hydro-electric project. Construction expected to start in 2004; metal production in 2007. Agreement between Gulf international Investment Group and Dubai Aluminium Co.	
	Perak State Development Corporation/Malaysia Aluminum Smelting Co. (Charus Development Corporation)	Potential new smelter to start construction in 2003. First stage 230 000 t/y with potential expansion to 690 000 t/y. Proponents seeking funding and approvals.	
Mozambique	Mozal - Billiton and partners	Expansion of capacity of the Mozal smelter under way from 250 000 t/y to 500 000 t/y. Management contract awarded to SNC Lavalin of Canada and Murray and Roberts Engineering Solutions of South Africa. Initial production expected in mid-2003.	250 000
Nigeria	Ikot-Abasi	Work under way to re-open the 193 000-t/y smelter. Government sale of interest expected in 2003.	
Norway	Karmøy, Årdal - Hydro Aluminium	Higher power costs resulted in reductions in planned production at Karmoy. Soderberg technology to be phased out by 2006 at Årdal; by 2009 at Karmøy.	-10 000
	Mosjøen - Elkem	Modernization and expansion under way; 60% complete in early 2002. Expansion to be completed in 2003.	68 000
	Soeral	Alcan/Norsk Hydro expansion of 44 000 t/y to be completed first quarter of 2003.	
	Sunndal - Hydro Aluminium	New prebake potline nearing completion; closure of older potline advanced due to higher power costs. Capacity to reach 330 000 t/y in 2004.	168 000
Qatar	Ras Laffan - United Development Co, Ferrostaal, and JGC Corp.	Consortium's proposal for smelter in NE Qatar; has licence to build smelter, contract for gas supply. Smelter capacity is 500 000 t/y. Production expected in 2006.	
Russia	Irkutsk-Alucom-Taishet	Pilot smelter built in 2002. Proposal for new 250 000-t/y smelter and difficulty with power for pilot plant. Russian Aluminium in discussions for purchase of interest. Project may be merged with Russian Aluminium proposal.	

TABLE 12 (cont'd)

Country	Project/Company	Remarks	Near-Term Change Amount
			(t/y)
Russia (cont'd)	Irkutsk - Sual Group	Potential new 200 000-t/y smelter at Irkutsk.	
	Komi smelter and refinery - Sual	Hatch and Associates awarded contract for prefeasibility and engineering work on alumina refinery and smelter. Smelter capacity expected to be 300 000-500 000 t/y.	
	Leningrad - Vsevolozhsk aluminum smelter	Feasibility studies and decision on environmental approvals on a proposed 147 000-t/y smelter with associated rolling plant expected in 2003.	
	Leningrad - Sosnovy Bor Aluminum Works - Alutec Inc.	Studies continue on proposed new smelter; USTDA grant for research and design. Construction could start in 2003 on smelter. First stage of 60 000 t/y could be operational in 2004 with expansions thereafter to 360 000 t/y.	
	Leningrad - Metallurg (Volkhov Aluminum and Glinozyom)	Possible expansion from 20 000 t/y to 60 000 t/y.	
	Primoriye - Russian Aluminium	Discussions on a potential new smelter to be associated with new hydro-electric power project.	
	Sayansk - Russian Aluminium	SNC Lavalin-Russian Aluminium Memorandum of Cooperation on expansion study and feasibility study for expansion of smelter from 400 000 t/y to 660 000 t/y. Loan obtained for modernization.	
	Kandalaksha smelter - Sual Group	Replacement of older cells with prebaked anode cells to start in 2003. Work to be done over four years increasing cap to 114 000 t/y.	
	Murmansk (Kola Peninsula) - Russian Aluminium	Studies for a possible new 300 000-t/y smelter.	
	Sayanogorsk - Russian Aluminium	Upgrading expected to boost capacity by 30 000 t/y in 2003. Planning for second phase increase in production by 290 000 t/y. Cooperation agreement with Norsk Hydro on modernization of cast house and increase in billet capacity.	30 000
	Uralsky smelter - Sual Group	Potlines being replaced/upgraded; completion expected in 2003 to raise capacity to 105 000 t/y.	36 000
Slovakia	Ziar-nad-Hronom - Slovalco A.S.	Expansion of smelter under way; completion expected in 2003.	40 000
Slovenia	Kidricevo Talum d.o.o. smelter	Expansion of smelter under way; completion expected in 2003.	50 000
South Africa	Coega - Pechiney and others	Proposed smelter likely to be constructed near Port Elizabeth in South Africa. New US$2.2 billion 460 000-t/y AP50 smelter planned. Pechiney seeking financing partners.	
	Hillside smelter - BHP-Billiton	Expansion expected to produce first metal in early 2004.	132 000
Ukraine	Pervomaisk - Russian Aluminium	Planning under way for a new smelter, part of agreement for purchase of existing facilities. Capacity 120 000-180 000 t/y.	
United States	Golden Northwest Aluminum	Restarted closed potline in September (50 000 t/y).	50 000
	Badin - Alcoa	Production temporarily suspended in August (120 000-t/y capacity but operating at 90 000 t/y).	-90 000
	Ferndale (Intalco) - Alcoa	Plans to re-open third potline have been shelved due to power increases.	
	Tacoma - Kaiser	Property and smelter sold to Port Authority. Plant was closed in 2000 due to high power costs. Capacity was 73 000 t/y.	
	Mead - Kaiser	Announced indefinite closure in January 2003. Plant was closed in 2000 due to high power costs. Capacity was 200 000 t/y.	
	Rockdale - Alcoa	Announced permanent closure of idled capacity in July (76 000 t/y).	
	Troutdale - Alcoa	Announced permanent closure in July (120 000 t/y).	
	Columbia Falls Aluminum Co	Closing two of three potlines in 2003.	-67 000
Venezuela	Alcasa - CVG	Modernization and restarting of potlines to production of 210 000 t/y. Expanding anode capacity and plans new potline with additional 240 000-t/y capacity. Contracts awarded in early 2003 with construction to start in 2003; production expected in 2006.	50 000
	Venalum - CVG	Plans new potline with additional 160 000-t/y capacity.	
	Aleaciones Ligeras, Alisa, SA	Planning for new smelter in the Guayana region. First stage of 55 000 t/y would be part of an eventual 220 000-t/y plant.	
Total			3 923 000

Source: Natural Resources Canada, based on published media reports.

Antimony

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(Note: This is a brief review of antimony in Canada with general information and not a comprehensive review.)

The chemical symbol for antimony is Sb.

Canada produces a very minor share, 0.1 %, of the approximately 143 000 t that the United States Geological Survey (USGS) estimated to have been produced worldwide in 2002. The second largest producer of antimony is South Africa, which produces 4% of the world's total production. China is the dominant force in the world antimony market, producing an estimated 91% of world production, according to USGS data.

The largest single application for antimony is in the manufacture of flame retardants used in plastics, vinyls and synthetic fibres. Antimony is also used as an alloying element in lead for making automotive batteries; the addition of antimony increases the strength and hardness of the lead. When lead-acid automotive and lead-acid standby batteries are recycled, much of the contained antimony can be recovered for making antimonial lead for use in the battery-making process. Antimony metal is also used in solders and for bearings. Stibnite (Sb_2S_3) is the predominant ore mineral of antimony. Antimony metal is sold as regulus grading 96% Sb. Prices for antimony largely depend upon Chinese production (Figure 1); with the increased production from China, prices have declined dramatically since 1994.

Antimony is alloyed with lead to improve the hardness. The resultant "hard lead," with a 3-9% antimony content, has superior strength and corrosion resistance relative to unalloyed lead. Hard lead is used in the grids, terminals and lead-oxide paste of automotive and standby batteries. In addition, antimonial lead lining is used to protect pipes, valves, pumps and sheets used in the chemical industry. Higher antimony contents of up to 13% are needed for casting alloys.

Other elements can be used to harden lead, such as cadmium, calcium, copper, selenium, strontium, sulphur or tin. Hydrated aluminum oxide and certain organic compounds can be used for flame retardants. In paints, pigments and enamels, various compounds of chromium, tin, zinc or zirconium can be used in place of antimony.

CANADIAN DEVELOPMENTS

Antimony is recovered in Canada from primary concentrates and from recycled automotive batteries at two primary lead smelters that produce antimony-lead alloys. These alloys are used for lead-acid battery production. Canadian antimony mines remained closed, primarily due to low antimony prices. In addition, there are two lead smelters that recycle antimonial lead from spent lead-acid batteries and other sources.

Teck Cominco Limited (www.teckcominco.com) operates lead-zinc mines whose ore contains significant amounts of by-product antimony. At its Trail, British Columbia, lead-zinc smelter/refinery, Cominco recovers antimony from concentrates and from recycled lead-acid batteries in order to produce an antimony-lead alloy.

Noranda Inc. (www.noranda.com) operates the Brunswick lead-zinc mine at Bathurst, New Brunswick, where the ore contains significant amounts of by-product antimony. At Noranda's lead smelter located in Belledune in the same province, the company recovers antimony from concentrates and from recycled lead-acid batteries in order to produce an antimony-lead alloy.

The two Canadian secondary lead smelters use scrap batteries for feed and these batteries contain antimony alloyed with the lead; the antimony in these batteries can be recovered with the lead. The two secondary lead smelters are owned by Tonolli Canada Ltd. in Toronto, Ontario, and Nova Pb Inc. (www.novapb.com) near Montréal, Quebec. These two plants are dependent upon recyclable lead-acid batteries from neighbouring states, such as New York, to supplement feed from Canadian sources; without such imports, there is insufficient feed in Canada to keep both plants operating viably. The Nova Pb plant commenced recycling of spent aluminum pot lining at the end of 2002. This reduces the plant's capacity by 50% to 45 000 t/y of lead.

Canadian Antimony Mines

Canadian antimony mining has ceased due to the low price of antimony brought about by the large volume of Chinese exports.

Apocan Inc., a subsidiary of Amspec of the United States (www.amspecorp.com), owns the Lake George antimony mine in New Brunswick. Lower antimony prices forced the mine's closure in 1989. In mid-1994, Apocan decided to proceed with permitting and the rehabilitation work needed to re-open the mine. In October 1995, final permits were obtained for the mine re-opening. The mine started producing in mid-1996 and was officially opened in November 1996. However, mechanical problems with the hoist forced a shut-down of the operation at year-end. Before repairs could be completed, antimony prices dropped so low that the company decided to keep the operation shut. Since that time, the mine was permitted to flood. In the mid-1990s, the company considered building an antimony smelter to process the concentrate but there was significant local opposition to the idea. With the increase in prices in late 2002, which saw monthly antimony prices[1] exceed US$2500/t for the first time since September 1996, it was expected that the company would evaluate re-opening the operation; however, the mine remained closed throughout 2002 and into 2003.

An information page discussing antimony is available from a New Brunswick government web site at www.gnb.ca/0078/minerals/antimony_bismuth-e.pdf. A contact in the provincial government for further information about antimony is John Griggs (e-mail John.Griggs@gnb.ca).

In Newfoundland and Labrador, the Beaver Brook antimony deposit was developed by Roycefield Resources Ltd. In the 1990s, the company developed a 0.5-km ramp and undertook lateral development, including test mining of about 20 000 t of development ore grading about 5% Sb. The 400-t/d mill began operation in November 1997 and the first concentrate was shipped to Amalgamet Canada Limited (www.amalgamet.com) prior to the end of 1997.

Roycefield also built a hydrometallurgical demonstration plant to produce antimony trioxide. The company estimated the cost of a commercial hydrometallurgical plant at about $17 million. Continued low antimony prices forced Roycefield to suspend the commissioning of the 400-t/d mill in February 1998 and the operation was put on care and maintenance in 1999. Thereafter, Beaver Brook Resources Inc. was reported to have purchased the property from Roycefield, which had entered into receivership. It is believed that Beaver Brook Resources is a private company.

A geological map of the island of Newfoundland showing the location of the Beaver Brook deposit is available on the internet at www.gov.nl.ca/mines&en/geosurvey/maps/pros_envir_Nfld.pdf. For more information about antimony in the province, contact John Clarke (e-mail edwardclarke@gov.nl.ca).

PRICES

Metal Bulletin's free market prices for antimony regulus grading 99.65% Sb with a maximum selenium content of 50 ppm are shown in Figure 1 for the period 1993 to 2002. Prices increased rapidly from US$1569/t in July 1993 to reach a maximum of US$5955/t in November 1994. This large price increase of nearly 380% in 16 months encouraged producers to increase production capacity either through the development of antimony sources or the re-opening of those mines previously shut down. In addition, manufacturers began recycling their off-specification material while producers concentrated on increasing recovery rates. Simultaneously, however, the rapid price increase and high price discouraged future antimony use.

For the period 1993 to September 2002, monthly prices peaked at US$5995/t; they then declined to US$2975/t by June 1995 and recovered rapidly to US$4787/t by August 1995. From then onward, prices trended downwards to US$1109/t in April 2000. Since that time, prices drifted upwards to US$1844/t and then declined to US$1493/t by year-end 2000, reaching a nadir of US$1025/t in August 2001. Since then, prices have increased. The increase was hastened by problems at Chinese mines in the summer of 2002, which sent prices up to an average of US$3300/t in October 2002. Prices then declined steadily to an average of US$2162/t for November 2003, the last month for which data were available at the time of writing.

As can be seen from the USGS data, China is the dominant antimony producer, producing over 90% of the world's mine supply. Figure 2 shows Chinese and world production of antimony from 1997 to 2002. Data for 2002 are estimated.

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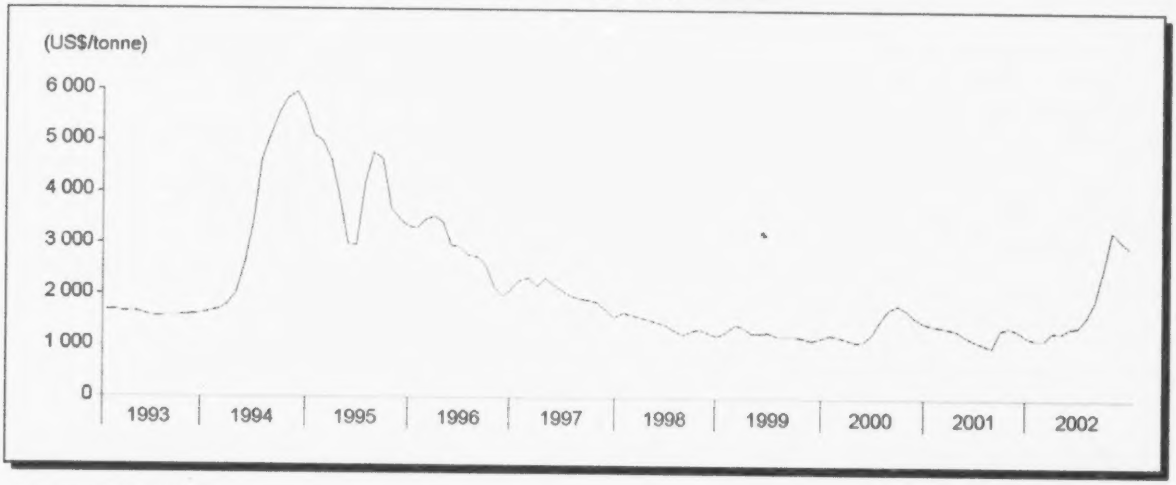
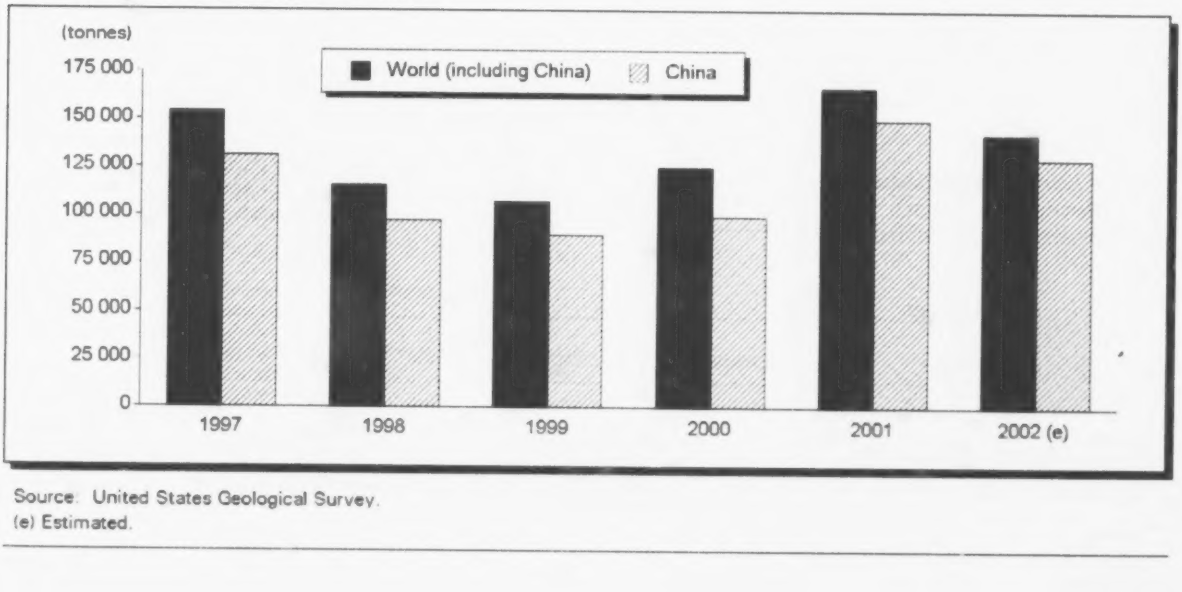
[1] *Metal Bulletin* average of the monthly high and monthly low prices. The price stated is for antimony regulus in warehouse grading a minimum of 99.65% Sb with a maximum selenium content of 50 ppm.

Figure 1
Antimony Prices, *Metal Bulletin* Monthly Average, (1) 1993-2002



Source: *Metal Bulletin.*
(1) Average of *Metal Bulletin's* monthly low and high prices, European price, in warehouse, regulus 99.65%, max. Se 50 ppm.

Figure 2
Antimony Production, 1997-2002



Source: United States Geological Survey.
(e) Estimated.

INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet include:

- United States Geological Survey (USGS): http://minerals.usgs.gov/minerals/pubs/commodity/antimony/
- Search by company name in the SEDAR data base for companies publicly traded in Canada: www.sedar.com/ search/search_form_pc_en.htm
- *Canadian Mining Journal:* www.canadianminingjournal.com
- *The Northern Miner* (daily headlines): www.northernminer.com
- Various on-line encyclopedias
- any web search engine such as www.google.com/advanced_search
- For physical and chemical properties, concentrations in various media, etc.: www.webelements.com/webelements/elements/text/Sb/key.html
- Yahoo search of metals and minerals (use keyword "antimony"): http://search.news.yahoo.com/search/news/?n=10&p=antimony
- *American Metal Market,* search (some articles do not require paid subscription to access): www.amm.com
- *Mining Journal,* search (some articles do not require paid subscription to access): www.mining-journal.com/index1.htm
- *Metal Bulletin* (information by paid subscription): www.metalbulletin.co.uk

COMMERCIALLY AVAILABLE INFORMATION

More detailed information is available for purchase from Roskill Information Services Ltd. in the United Kingdom. Further information is available at the company's web site at www.roskill.co.uk/antimony.html.

Studies from other sources may also be available.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of November 2003. (3) This article is not intended to be a comprehensive overview of the industry but, rather, is a brief report to provide information about antimony in Canada. More detailed information is available from the United States Geological Survey, whose web site is noted above. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada			United States	EU
		MFN	GPT	USA	Canada	MFN
2617.10	Antimony ores and concentrates	Free	Free	Free	Free	Free
2825.80	Antimony oxides	Free	Free	Free	Free	6.6%
2918.13.00.10	Antimony potassium tartrates	Free	Free	Free	Free	6.5%
81.10	Antimony and articles thereof, including waste and scrap					
8110.10.00.10	Unwrought antimony; not alloyed; powders, not alloyed	Free	Free	Free	Free	7%
8110.10.00.20	Unwrought antimony, alloyed; waste and scrap; powders, alloyed; articles of antimony	Free	Free	Free	Free	Free-7%

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002).

TABLE 1. CANADA, ANTIMONY PRODUCTION, IMPORTS AND EXPORTS, 2000-2002, AND USE, 1997-2001

Item No.		2000		2001		2002 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION							
	New Brunswick	149 400	320	136 000	302	143 000	395
	British Columbia	214 700	461	97 771	217	–	–
	Total	364 100	781	233 771	518	143 000	395
IMPORTS							
2617.10	Antimony ores and concentrates						
	United States	23	67	14	50	23	72
	Other countries	. . .	1	–	–	–	–
	Total	23	68	14	50	23	72
2825.80	Antimony oxides						
	United States	1 716	5 801	1 400	4 841	1 521	5 979
	Mexico	–	–	146	391	83	278
	Belgium	105	310	132	354	81	236
	China	81	202	79	205	72	203
	Other countries	159	569	. . .	–	. . .	. . .
	Total	2 061	6 882	1 756	5 791	1 757	6 696
2918.13.10.10	Antimony potassium tartrates						
	Italy	66	97	58	118	66	109
	China	15	23	21	38	15	18
	United States	5	10	15	25	10	14
	Switzerland	4	8	1	3	1	1
	Other countries	. . .	. . .	. . .	. . .	. . .	. . .
	Total	90	138	95	184	92	142
8110.00.10	Unwrought antimony, not alloyed; powders, not alloyed						
	United States	112	413	77	257	–	–
	China	13	157	33	119	–	–
	Hong Kong	11	43	13	37	–	–
	Sweden	–	–	2	8	–	–
	Other countries	13	41	1	4	–	–
	Total	177	654	126	425	–	–
8110.00.20.00	Unwrought antimony; waste and scrap; powders, alloyed; articles of antimony						
	China	105	268	152	349	–	–
	United States	173	404	85	199	–	–
	Hong Kong	–	–	45	77	–	–
	Germany	15	52	18	73	–	–
	Other countries	12	30	19	52	–	–
	Total	305	754	319	750	–	–
8110.10.00.10	Unwrought antimony; not alloyed; powders, not alloyed						
	United States	–	–	–	–	134	437
	China	–	–	–	–	26	105
	Germany	–	–	–	–	16	55
	Other countries	–	–	–	–	5	15
	Total	–	–	–	–	181	612
8110.10.00.20	Unwrought antimony; waste and scrap; powders, alloyed; articles of antimony						
	United States	–	–	–	–	96	311
	China	–	–	–	–	80	233
	Germany	–	–	–	–	8	18
	Total	–	–	–	–	184	562
	Total imports		8 496		7 200		8 084

TABLE 1 (cont'd)

Item No.		2000		2001		2002 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
EXPORTS							
2617.10	Antimony ores and concentrates	–	–	–	–	58 179	66 318
2825.80	Antimony oxides						
	United States	–	–	20	43	–	–
8110.00	Antimony and articles thereof, including waste and scrap						
	United States	62	444	69	425	–	–
	Germany	–	–	. . .	21	–	–
	Other countries	. . .	3	. . .	16	–	–
	Total	62	447	69	462	–	–
8110.20	Antimony waste and scrap						
	United States	–	–	–	–	6	60
8110.90	Antimony and articles thereof, including waste and scrap						
	United States	–	–	–	–	48	564
	Other countries	–	–	–	–	. . .	12
	Total	–	–	–	–	48	576
	Total exports		447		505		66 954

		1997 (a)	1998	1999	2000	2001 (p)
				(kg)		
USE (1)						
	Antimony metal used for, or in the production of:					
	Antimonial lead	1 082 374	695 539	792 018	713 226	451 263
	Babbit	65 032	70 162	62 669	56 369	59 015
	Other uses (2)	10 804	25 554	10 696	7 910	6 977
	Total	1 158 210	791 255	865 383	777 505	517 255
	Held by users on December 31 (1)	431 702	89 336	248 754	304 213	202 208

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary.
(a) Increase in number of companies being surveyed.
(1) Available data as reported by users. (2) Includes solder, type metal and miscellaneous uses.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, USE AND USERS' STOCKS OF ANTIMONY,(1) 1970, 1975 AND 1980-2002

	Use		On Hand at End of Year	
	Antimony Metal	Antimonial Lead Alloy (2)	Antimony Metal	Antimonial Lead Alloy (2)
		(kilograms)		
1970	518 007	635 212	131 501	91 563
1975	454 164	723 155	116 760	170 478
1980	369 732	643 983	42 389	51 405
1981	209 829	691 180	35 105	151 400
1982	161 034	605 502	39 799	76 979
1983	169 648	560 705	24 381	130 104
1984	342 705	648 413	33 524	23 319
1985	184 993	826 846	24 512	20 298
1986	539 655	759 876	28 422	104 360
1987	540 147	692 750	21 172	164 782
1988	585 600	989 100	7 386	142 961
1989	442 942	1 075 354	17 023	135 977
1990	294 321	922 127	13 805	99 882
1991	406 221	924 728	20 248	131 779
1992	355 963	829 795	99 872	149 850
1993	688 542	(r) 884 344	41 123	(r) 127 382
1994	1 084 863	856 959	80 123	135 267
1995	988 338	822 848	150 064	208 132
1996	688 800	733 730	153 734	115 878
1997	1 158 210	665 751	431 702	156 725
1998	791 255	589 087	89 336	190 962
1999	865 383	634 294	248 754	323 633
2000	777 505	(a) 674 829	304 213	250 406
2001	517 255	626 365	202 208	215 997
2002 (p)	487 013	671 706	278 740	98 252

Source: Natural Resources Canada.
(p) Preliminary; (r) Revised.
(a) Increase in number of companies being surveyed.
(1) Available data, as reported by users. (2) Antimony content of primary and recycled antimonial-lead alloys.

TABLE 3. MINE PRODUCTION OF ANTIMONY, 1994-2002

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002
					(tonnes)				
China	91 000	125 000	129 000	131 100	97 400	89 600	99 300	(r) 97 000	121 550
South Africa	4 540	5 540	5 140	3 420	4 240	5 280	4 100	4 830	5 000
Russia	3 000	3 000	6 000	6 000	4 000	4 360	8 000	4 150	4 000
Tajikistan	2 000	1 000	1 000	1 200	1 500	1 800	2 000	2 500	3 000
Kyrgyzstan	9 590	4 780	6 000	3 062	1 300	1 320	1 505	1 500	1 500
Bolivia	7 050	6 430	6 490	6 000	4 740	2 790	1 910	(r) 2 260	1 390
Australia	1 300	900	1 800	1 900	1 800	1 680	1 510	1 380	1 200
Other	4 050	4 120	4 830	3 440	2 480	1 610	1 420	710	1 040
Total	122 526	150 765	160 255	156 120	(r) 117 456	(r) 108 431	(r) 119 748	(r) 114 336	138 672

Source: International Consultative Group on Nonferrous Metals Statistics, 2003.
(r) Revised.
Notes: Data in table rounded by author to nearest 10 tonnes so totals may not add. Data do not necessarily agree with USGS data.

Bismuth

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(Note: This is a brief review of bismuth in Canada with general information and not a comprehensive review.)

The chemical symbol for bismuth is Bi.

As the only "edible" heavy metal, bismuth is used in pharmaceutical products such as non-prescription stomach remedies, which contain bismuth subsalicylate. Bismuth is also used in antibiotics that treat stomach ulcers and burns.

In metallurgy, bismuth is used as an additive or alloying element, for example, as a hardening agent in lead used in lead-acid automotive and standby batteries. Bismuth's low melting point is utilized in fusible links, which are used to engage automatic fire sprinkler systems. When bismuth solidifies, it expands, unlike most other metals. This property improves "pressure tightness" and reduces shrinkage when bismuth is added to alloys. Other bismuth applications include use in ceramics, glass, electronics and cosmetics.

The outlook for bismuth use is thought to be encouraging due to increasing restrictions on the use of lead. Such restrictions have meant that bismuth is used to replace lead in some potable water equipment, as a substitute for shotgun pellets used to hunt waterfowl, and to increase the machineability of alloys.

The world mine production of bismuth in 2002 was estimated by the United States Geological Survey (USGS) to have been 4070 t, 86% of which was produced by China, Mexico and Peru (Figure 2). According to the USGS, Canada produced about 4% of the world's bismuth at the mine stage. In 2002, China, Mexico, Belgium and Peru produced 79% of the world total of 5190 t of refined bismuth, according to the USGS.

CANADIAN DEVELOPMENTS

Canadian primary bismuth production for the period 1995 to 2001 is shown below.

Canadian refined bismuth production data are withheld for confidentiality reasons.

On average, for the period 1995 to 2002, 85% of Canadian-mined bismuth originated in New Brunswick from Noranda Inc.'s (www.noranda.com) Brunswick mine. Bismuth is a by-product of lead-zinc mining at the Brunswick mine at Bathurst. The metal is recovered at Noranda's lead smelter in Belledune, New Brunswick, as an intermediate bismuth lead alloy.

Teck Cominco Limited (www.teckcominco.com) recovers bismuth metal from the concentrate feed to its Trail, British Columbia, lead-zinc operation.

PRIMARY BISMUTH PRODUCTION IN CANADA, 1995-2002

	New Brunswick	British Columbia	Total	Value
		(tonnes)		($000)
1995	148	11	159	1 815
1996	w	w	150	1 598
1997	182	14	196	1 956
1998	175	11	186	2 078
1999	249	16	264	2 941
2000	194	8	202	2 343
2001	252	6	258	3 176
2002 (p)	189	–	189	1 905
Total	1 389	66	1 604	17 812

Source: Natural Resources Canada.
– Nil; (p) Preliminary; w Withheld.
Note: These data do not include bismuth recovered from recycling.

From 1995 to 1996, Adex Mining Corp. evaluated the Mt. Pleasant property in New Brunswick. Adex took bulk samples and undertook a metallurgical research program at the site of the former mine as part of a feasibility study for the production of tin and indium. The ore under consideration also contained 0.08% bismuth. Due in large part to the low indium prices in 1997 and the high estimated capital cost, Adex was unable to develop the orebody. At a rate of 2000 t/d, the mine would have produced approximately 400 t/y of bismuth, thereby increasing primary world bismuth supply by over 10%. The company was delisted in June 1999 but continues to hold the Mt. Pleasant property. Adex did not maintain a web site at the time this article was written. The site where Adex provides filings to securities regulators at www.sedar.com/command_servlet?cmd=Display CompanyDocuments&issuerNo=00002586&lang=EN did not show any submissions later than December 7, 1998.

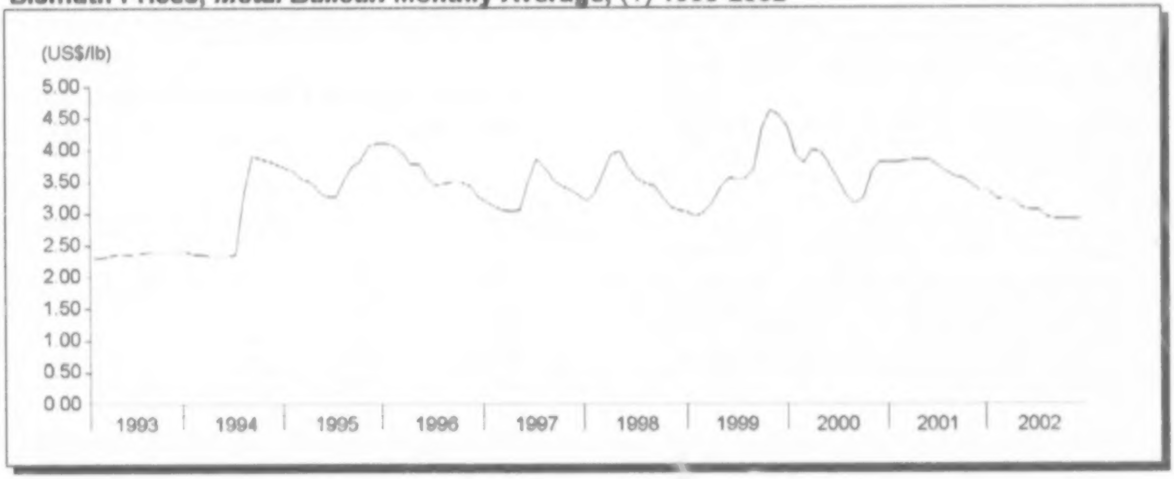
An information page discussing bismuth is available from the New Brunswick government web site at www.gnb.ca/0078/minerals/antimony_bismuth-e.pdf. A contact in the provincial government for further information about bismuth is John Griggs (e-mail John.Griggs@gnb.ca).

Fortune Minerals Limited (www.fortuneminerals.com) owns 80% of the NICO gold-cobalt-bismuth deposit located 160 km from Yellowknife, Northwest Territories. During the year Strathcona Mineral Services completed a scoping-level economic assessment of the deposit followed by a a second study to assess a scenario involving predominantly underground development supplemented by ore from two smaller open pits. As of the end of 2002, diluted mineable indicated resources at the deposit to be mined by underground methods were 4.48 Mt grading 3.55 g/t gold, 0.16% cobalt and 0.25% bismuth in addition to the 2.7 Mt grading 0.73 g/t gold, 0.12% cobalt and 0.15% bismuth to be mined by open-pit methods. The bismuth could be trucked to Trail, British Columbia, for processing at Teck Cominco Limited's smelter. Fortune's filings with securities regulators are available at www.sedar.com/command_servlet?cmd=Display CompanyDocuments&issuerNo=00002470&lang=EN.

PRICES

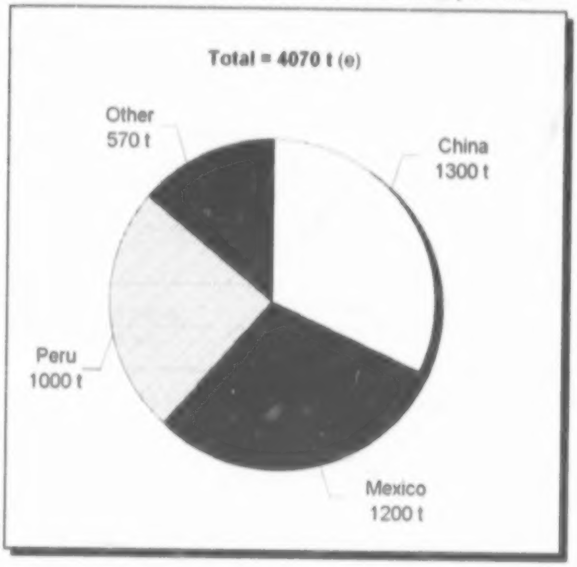
Monthly *Metal Bulletin* prices from 1995 to 2002 are shown in Figure 1. The average of the *Metal Bulletin* high monthly and low monthly average prices for bismuth declined in 2002 from US$3.22/lb to US$2.90/lb, reaching US$2.95/lb in August 2003. More detailed price information is available from the Sidech web site at www.sidech.be/graph.htm.

Figure 1
Bismuth Prices, *Metal Bulletin* Monthly Average, (1) 1993-2002



Source: *Metal Bulletin*.
(1) Average of *Metal Bulletin's* monthly low and high prices, European price, in warehouse, 99.99% min., tonne lots.

Figure 2
World Mine Production of Bismuth, 2002



Sources: Data from U.S. Geological Survey.
(e) Estimated.

PRODUCT INFORMATION

Those who wish to purchase bismuth should contact the producers. In Canada the following firms produce and sell bismuth:

• Teck Cominco Limited	www.teckcominco.com
• Falconbridge Limited	www.falconbridge.com

Additional information such as addresses and phone numbers can be found on their web sites.

INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet, current to October 2003, include the following:

- United States Geological Survey (USGS): http://minerals.usgs.gov/minerals/pubs/commodity/bismuth/
- Search by company name in the SEDAR data base for companies publicly traded in Canada: www.sedar.com/search/search_form_pc_en.htm
- *Canadian Mining Journal:* www.canadianminingjournal.com
- *The Northern Miner* (daily headlines): www.northernminer.com
- Various on-line encyclopedias
- Any web search engine such as www.google.com/advanced_search
- For physical and chemical properties, concentrations in various media, etc.: www.webelements.com/webelements/elements/text/Bi/key.html
- *American Metal Market,* search (some articles do not require paid subscription to access): www.amm.com
- *Mining Journal,* search (some articles do not require paid subscription to access): www.mining-journal.com/index1.htm
- *Metal Bulletin* (information by paid subscription): www.metalbulletin.co.uk

OUTLOOK

Bismuth is a by-product metal; the bismuth revenue in the ore mined is only a fraction of the total ore value in almost all cases. When bismuth prices increase because of sharply increased demand, many operations do not have the capacity to increase production significantly. Because the bismuth constitutes only a small fraction of the revenue produced at the mine, producers will not increase ore production only because bismuth prices increase. While most metal prices are volatile, the price of minor by-products such as bismuth can be much more volatile due to the inability of producers to capitalize on increased demand. The ability of bismuth to substitute for lead is constrained by the higher price for bismuth and by the inability of the bismuth industry to substantially increase production.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of October 2003. (3) This article is not intended to be a comprehensive overview of the industry but, rather, is a brief report to provide information about bismuth in Canada. More detailed information is available from the United States Geological Survey, whose web site is noted above. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2617.90.00.90	Bismuth ores and concentrates	Free	Free	Free	Free
8106.00.10	Unwrought bismuth, not alloyed; powders, not alloyed	Free	Free	Free	Free
8106.00.20	Unwrought bismuth, alloyed; waste and scrap; powders, alloyed; articles of bismuth	Free	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003.

TABLE 1. CANADA, BISMUTH PRODUCTION AND TRADE, 2000-2002, AND USE, 1997-2001

Item No.		2000		2001		2002 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION (all forms) (1)							
	New Brunswick	194 230	2 250	251 530	3 102	189 333	1 905
	British Columbia	7 998	93	6 023	74	–	–
	Total	202 228	2 343	257 553	3 176	189 333	1 905
EXPORTS							
8106.00	Bismuth and articles thereof, including waste and scrap						
	United States	120 275	1 228	42 510	447	49 822	516
	Belgium	20 134	207	20 117	212	41 509	371
	Ukraine	–	–	700	11	847	19
	France	69	1	–	–	–	–
	Germany	61 363	715	–	–	–	–
	Other countries	79 178	886	34 550	402	–	–
	Total	281 019	3 037	97 877	1 072	92 178	906
IMPORTS							
2836.99.10.10	Bismuth carbonates						
	France	–	–	–	–	750	128
	Germany	150	. . .	544	2	778	2
	Spain	1 495	4	7 574	22	249	1
	United States	283 295	849	126 560	387	285	1
	Total	284 940	853	134 678	411	2 062	132
8106.00.00.10	Unwrought bismuth, not alloyed; powders, not alloyed						
	China	29 740	357	66 640	584	26 909	259
	Belgium	8 072	113	11 158	161	8 511	122
	United Kingdom	4 842	56	7 503	76	7 687	109
	United States	7 567	99	32 872	171	2 787	30
	Other countries	7 899	28	2 473	41	297	5
	Total	58 120	653	120 646	1 033	46 191	525
8106.00.00.21	Unwrought bismuth, alloyed; powders, alloyed, articles of bismuth						
	United States	5 149	187	2 329	140	2 660	127
	Sweden	–	–	–	–	127	10
	United Kingdom	–	–	100	5	20	5
	Italy	–	–	–	–	178	4
	Mexico	–	–	1 092	17	–	–
	Total	5 149	187	3 521	162	3 005	146
8106.00.00.22	Bismuth waste and scrap						
	United States	74 524	936	56 161	741	44 148	583
	Singapore	–	–	–	–	147	2
	China	981	12	–	–	–	–
	Other countries	–	–	4 307	52	–	–
	Total	75 505	948	60 468	793	44 295	585
	Total imports		2 641		2 399		1 388

		1997	1998	1999	2000	2001 (p)
				(kg)		
USE (1)						
	Use, refined metal (available data)					
	Fusible alloys and other alloys	10 846	14 641	17 066	12 553	x
	Other uses	–	–	–	–	x
	Total	10 846	14 641	17 066	12 553	20 272

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.
(1) Available data as reported by users.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, BISMUTH PRODUCTION AND USE, 1970, 1975 AND 1980-2002

	Production All Forms (1)	Use (2)
	(kilograms)	
1970	. .	11 135
1975	156 605	29 267
1980	149 366	10 271
1981	167 885	10 094
1982	(r) 189 132	10 074
1983	253 023	7 241
1984	(r) 166 177	9 398
1985	201 489	7 284
1986	152 930	6 617
1987	165 282	4 547
1988	180 907	6 709
1989 (a)	156 727	16 158
1990	74 300	12 032
1991	59 526	11 877
1992	203 789	9 859
1993	128 870	12 133
1994	129 371	12 585
1995	158 641	12 838
1996	149 839	13 118
1997	195 720	10 846
1998	186 400	14 641
1999	217 135	17 066
2000	202 228	12 553
2001	257 553	20 272
2002 (p)	189 333	. .

Source: Natural Resources Canada.

. . Not available; (p) Preliminary; (r) Revised.

(a) Increase in number of companies being surveyed.

(1) Refined bismuth metal from Canadian ores, plus recoverable bismuth content of bullion and concentrates exported. (2) Refined bismuth metal reported by users.

Calcium Metal

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(Note: This is a brief review of calcium metal in Canada with general information and not a comprehensive review.)

The chemical symbol for calcium is Ca.

Timminco Limited (www.timminco.com) has the sole production facility for calcium metal in Canada located in Timminco's plant at Haley Station, Ontario, where the company produces very high-purity magnesium. The installed capacity of the calcium metal production facilities in 1995 was about 900 t/y. The calcium metal production line has been idle for a number of years due to low prices for the metal that have resulted from increasing exports from China. Timminco estimated that the Western World use of calcium metal in 2002 amounted to about 5000 t.

Timminco also operates a metal reduction and casting plant in Westmeath, Ontario, located approximately 50 km west of the Haley facility near the town of Renfrew, Ontario. At the Westmeath plant, Timminco produces its proprietary specialties, CAL-AL™, MAG-CAL™ and particulated calcium metal. These products command a premium over the price of commodity-grade calcium metal. The plant is currently operated using imported calcium metal. In addition, the Westmeath plant produces other specialty materials such as strontium-aluminum alloys and aluminum granules. Other calcium metal producers are located in Russia, the United States (Materials Technologies Inc.), France (Pechiney Électrométallurgie) and China. The calcium-related operations of Pechiney Électrométallurgie, including the metal plant at La Roche de Rame, plus the calcium-related operations of SKW Metallurgie, of Germany, were combined into a new subsidiary called SKW Stahl Holding. The new company, owned 75% by SWK Metallurgy and 25% by Pechiney Électrométallurgie, markets various products, including calcium alloys for use in metallurgical applications.

With only a few producers, public information about the industry is limited and prices have not been quoted since 2001.

Calcium metal is a powerful reduction agent that is used to deoxidize, desulphurize and degas steels and cast irons. In addition, calcium metal is used to reduce oxides of chromium, [illegible]m, samarium, thorium, titanium, uranium and vanadium. Because the metal is so reactive, alloys are often preferred to the pure metal.

Calcium is also used as an alloying element in lead for the manufacture of maintenance-free automotive batteries. Calcium metal, when alloyed with the lead, increases the alloy's strength, corrosion resistance, and creep resistance.

Additional information about calcium compounds is available at Timminco's web site.

PRICES

The list price in the *American Metal Market* for 4.5 t (10 000 lb) of full calcium crowns was US$3.85/lb in January 2001, a value that remained unchanged since the start of 1987. The list price for 4.5 t (10 000 lb) of cut crowns was higher at US$4.02/lb, unchanged since mid-1990. The actual transaction prices paid were likely dependent upon contract details such as quantity, frequency of delivery, impurities, etc. The *American Metal Market* discontinued listing prices of commercial-grade calcium metal in late 2001.

INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet, current to October 2003, include the following:

- United States Environmental Protection Agency: www.epa.gov/epaoswer/other/mining/minedock/id/id4-cal.pdf
- Search by company name in the SEDAR data base for companies publicly traded in Canada: www.sedar.com/search/search_form_pc_en.htm

- *Canadian Mining Journal:* www.canadianminingjournal.com
- *The Northern Miner* (daily headlines): www.northernminer.com
- Various on-line encyclopedias
- Any web search engine such as www.google.com/advanced_search
- For physical and chemical properties, concentrations in various media, etc.: www.webelements.com/webelements/elements/text/Ca/key.html
- *American Metal Market*, search (some articles do not require paid subscription to access): www.amm.com
- *Mining Journal*, search (some articles do not require paid subscription to access): www.mining-journal.com/index1.htm
- *Metal Bulletin* (information by paid subscription): www.metalbulletin.co.uk

COMMERCIALLY AVAILABLE INFORMATION

More detailed information is available for purchase from Roskill Information Services Ltd. in the United Kingdom. Further information is available on the company's web site at www.roskill.co.uk/calcium.html.

Studies from other sources may be available.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of November 2003. (3) This article is not intended to be a comprehensive overview of the industry but, rather, is a brief report to provide information about calcium in Canada. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

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TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
2805.12	Calcium metal	3%	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003.

TABLE 1. CANADA, CALCIUM METAL PRODUCTION AND TRADE, 2000-2002

Item No.		2000		2001		2002 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION		x	x	x	x	x	x
IMPORTS							
2805.12	Calcium						
	China	649 820	3 161	798 387	3 928	784 000	3 736
	France	4 189	62	18 507	265	59 368	786
	Germany	1	. . .	8	. . .	–	–
	Japan	12	. . .	–	–	23	. . .
	Kazakhstan	19 732	92	–	–	–	–
	Russia	102 908	499	65 424	330	144 743	650
	Taiwan	–	–	–	–	2 402	28
	United Kingdom	–	–	–	–	12	. . .
	United States	25 740	250	4 020	29	17 374	93
	Mexico	–	–	20 412	59	–	–
	Total	802 403	4 064	906 758	4 611	1 007 922	5 293
7202.99.00.92	Ferro-silico-calcium						
	France	1 902 906	4 959	1 384 843	3 440	1 891 653	5 103
	United States	185 865	563	210 405	624	133 352	318
	Argentina	51 319	104	88 863	168	40 876	77
	Brazil	195 445	367	63 000	110	–	–
	Germany	100	–	–	–	–	–
	United Kingdom	22 680	97	–	–	–	–
	Italy	–	–	443	2	–	–
	South Korea	–	–	5 143	13	–	–
	Total	2 358 315	6 090	1 752 697	4 357	2 065 881	5 498
EXPORTS							
2805.12	Calcium						
	Netherlands	79 900	687	85 147	648	96 599	611
	Japan	17 680	306	12 128	199	14 492	250
	United States	58 695	602	25 505	318	14 013	191
	Brazil	10 599	136	11 152	158	10 812	136
	Chile	3 372	36	6 093	85	2 726	53
	Australia	–	–	–	–	824	11
	Thailand	–	–	247	2	–	–
	Total	170 246	1 767	140 272	1 410	139 466	1 252

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.
Note: Numbers may not add to totals due to rounding.

Cement

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Shipments of cement in 2002 were estimated to be 13.2 Mt valued at $1.39 billion, based on preliminary data. This compares to shipments of 13.0 Mt valued at $1.35 billion in 2001, based on final data (Table 1). Demand for cement produced in most regions remained firm because of an increase of about 7% in gross expenditures on construction as well as stable exports.

CANADIAN INDUSTRY

The Canadian cement industry is diversified and primarily integrated with the construction aggregates and concrete products sectors. Information on the aggregates sector is included in a separate chapter entitled *Mineral Aggregates.*

Clinker-producing and finish-grinding capacities of cement plants are listed in Table 2. Reported kiln capacity in 2001 was about 15.8 Mt with about 15.1 Mt active, according to the most recent figures available. Primary stage clinker production mainly from limestone/shales is more indicative of ultimate cement production capacity because this is the most capital/energy-intensive stage and clinker can be stockpiled for later use or sale. The overall output of the cement industry has been best represented by total cement shipments plus clinker exports, as shown in Table 3. The average kiln capacity increased to 580 000 t/y in 2000; the average kiln age based on clinker capacity is reported to be about 20 years, according to the Portland Cement Association.

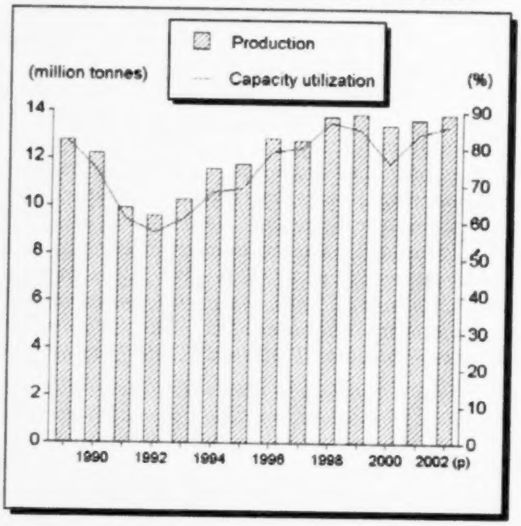
In the Atlantic region, the Lafarge Canada Inc. (Lafarge) plant in Nova Scotia is the only cement producer in the region following the closure in 2000 of the North Star Cement Limited plant in Corner Brook, Newfoundland.

In Quebec, three clinker-producing plants account for about 17% of Canada's output. St. Lawrence Cement Inc. (SLC), Lafarge, and Ciment Québec Inc. share markets about equally. (SLC continued with a permitting process to build a new 2-Mt/y cement plant near Greenport, New York.)

In Ontario, clinker-producing plants account for about 51% of Canadian capacity. The clinker/cement plants located in Bowmanville and St. Marys continued to operate under the name of St. Marys Cement (Canada) Inc., owned by Votorantim Cimentos, one of the largest industrial conglomerates in Brazil and its leading producer of cement. The former Blue Circle Inc. plant in Detroit, Michigan, operates as St. Marys Cement (U.S.) Inc.

Western Canada's clinker-producing capacity accounts for about 29% of Canada's total clinker capacity. Both the Inland Cement Limited plant and the Tilbury Cement plant currently operate under the names Lehigh Inland Cement and Lehigh Northwest Cement, respectively.

Figure 1
Canadian Cement Production, 1989-2002



Sources: Statistics Canada; Portland Cement Association.
(p) Preliminary.
Note: Cement production includes clinker exports.

WORLD DEVELOPMENTS

World cement production in 2001 was 1700 Mt, according to the United States Geological Survey (USGS). China is the world's largest producer (627 Mt), followed by India (100 Mt), the United States (90 Mt) and Japan (77 Mt).

U.S. anti-dumping duties against grey Portland cement and clinker from Mexico remained in effect in 2002.

USE AND TRADE

Cross-border trade of both cement and clinker varies considerably from year to year depending on construction activity. From 2000 to 2002, average annual exports of finished cement to the United States were 4.4 Mt, accounting for about one third of total Canadian production (producers' shipments plus quantities used by producers), as defined in Table 1. Exports are mainly destined for the southern Great Lakes and the U.S. Pacific northwestern regions. Similarly, Canada's imports of cement amounted to 0.6-0.8 Mt and related mainly to the equivalent regions.

Low-cost marine transportation has influenced world trade considerably. Total U.S. imports of cement (excluding clinker) were about 23 Mt in 2002, or 21% of apparent use. Asian sources, including China, Thailand and South Korea combined, have surpassed Canada as the major source of imports of cement and clinker, particularly since 1998, according to the USGS.

The importance of supplementary cementing materials (SCMs) for a range of uses is well recognized. About 1.0 Mt of fly ash, accounting for about 21% of reported production, were used in 2002, according to a recent survey by Natural Resources Canada (NRCan) in cooperation with the Canadian Electricity Association and the Association of Canadian Industries Recycling Coal Ash (CIRCA), as shown in Table 4. However, fly ash and other SCMs, important for their pozzolanic characteristics and other properties, are not differentiated in the international system of harmonized codes, hence, their recognition internationally tends to be diminished. (Also, timely official data relating to the total use of these materials as inputs to the hydraulic cement industry [SIC code 3521, and the equivalent NAICS code 327310], as well as to the concrete products industry [SIC codes 3541, 3542 and 3549, and their equivalent codes 327330 and 327390], are not readily available.)

TECHNOLOGY

Energy conservation programs by the Canadian cement industry have reduced the average energy consumption per unit of production by about 28% since 1974. Although the number of kilns has decreased, their individual capacities have increased and the more efficient dry-process plants now account for more than 95% of total active clinker capacity. The fuel mix has changed considerably away from natural gas and petroleum products toward coal and/or coke. In 2001, of 16 clinker-producing plants, 12 reported using coal and/or coke as their primary fuel. Seven plants reported using waste as an alternative or supplemental fuel, according to the Cement Association of Canada (CAC), formerly the Canadian Portland Cement Association (CPCA). In 2001, the Canadian cement industry consumed, on average, 4454 megajoules per tonne of clinker production. The types of fuel consumed, including waste fuels, are highlighted in Table 2.

Suitable waste materials are an attractive alternative fuel because the pyro-processing of clinker accounts for more than 80% of total energy needs, or 30-40% of total production costs. In the context of sustainable development of non-renewable fossil fuels, it is apparent that improved waste management involving combustion technology is leading to greater conservation.

Under the umbrella of the Working Group on Cement of the World Business Council for Sustainable Development (WGC-WBCSD), 10 major international cement groups have agreed upon a methodology for monitoring and reporting CO_2 emissions from clinker/cement processing. This initiative has been encouraged by guidelines issued by the Intergovernmental Panel on Climate Change (IPCC) concerning national greenhouse gas (GHG) inventories as these concern limitation or reduction commitments under the Kyoto Protocol. The major cement groups operate in most of the world's cement markets, and key projects include: (1) publication of individual performance data and targets for CO_2 emissions by 2006; (2) guidelines for the use of fuels and raw materials, including acceptable industrial by-products and wastes; and (3) establishing common reporting procedures along with a sharing of best practices.

NRCan continued to seek ideas, advice and financial support for the new International Centre for Sustainable Development of Cement and Concrete (ICON). Although this centre draws on some current initiatives and the expertise of the Canada Centre for Mineral and Energy Technology (CANMET), it is dependent upon new partnerships with industry, academic institutions and other governments for strengthening global efforts relevant to the sustainable development of cement and concrete.

An awareness of the importance of high-volume fly ash concrete is growing; for example, the Greater Vancouver Regional District has established a new web site for EcoSmart^{TM} concrete (high-volume fly ash concrete) in order to provide a forum for information about the benefits, costs and challenges associated with this type of concrete (www.ecosmart.ca/index.cfm?section=home). The EcoSmart Concrete Project also involves studying promising new techniques in intergrinding (blended cement) and precast (pre-manufactured) concrete. Some of these technical initiatives involve collaboration with CANMET and the Electric Power Research Institute (EPRI) of Palo Alto, California.

In 2003, and 2004, the Committee for the Organization of CANMET/ACI Conferences and the National Research Council's Institute for Research in Construction, as well as others, are planning four international conferences relating to cement and concrete. These are: (1) the Sixth CANMET/ACI International Conference on Durability of Concrete to be held in Thessaloniki, Greece, June 1-7, 2003; (2) the Sixth CANMET/ACI International Conference on Recent Advances in Concrete Technology to be held in Bucharest, Romania, June 8-11, 2003; (3) the Seventh CANMET/ACI International Conference on Superplasticizers and Other Chemical Admixtures in Concrete to be held in Berlin, Germany, October 20-24, 2003; and (4) the Eighth CANMET/ACI International Conference on Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete to be held in Las Vegas, United States, May 23-29, 2004.

Research efforts to develop new superplasticizers for use in conjunction with SCMs for high-performance concrete have increased in recent years. As a result of this, a publication entitled *Superplasticizers: Properties and Applications in Concrete*, by Ramachandran, Malhotra, Jolicoeur and Spiratos, was compiled to integrate the chemistry and applications concerned. This publication, which includes 14 chapters and more than 400 pages, can be obtained from NRCan's CANMET Materials Technology Laboratory by contacting Alan Bowles by telephone at (613) 995-8814 or by e-mail at abowles@nrcan.gc.ca.

NRCan, mainly in collaboration with the Canadian Industry Program for Energy Conservation (CIPEC), continued to develop long-term strategies related to major energy-consuming sectors.

OUTLOOK

Cement shipments in 2003 are expected to remain about the same as in 2002 based on continued strength in the housing sector, relatively low interest rates, and stable exports to the United States. Expenditures continued under the Infrastructure Canada Program involving federal, provincial/territorial and municipal governments. This program is expected to contribute about $6 billion relating to both building and engineering infrastructure during the six-year period up to and including 2005. In the longer term, considerable additional investment is expected to be associated with the 2010 Winter Olympics in British Columbia.

Other planned or possible major projects include: the Voisey's Bay nickel mine and processing plant as well as offshore oil field developments in Newfoundland and Labrador; additional oil sands developments in Alberta; hydro-electric power projects in Manitoba and British Columbia; additional airport expansions and nuclear power plant overhauls; and a high-speed rail link between Québec City and Windsor, Ontario.

Housing starts were about 205 000 in 2002, according to the Canada Mortgage and Housing Corporation. By way of comparison, housing starts were about 152 000 in 2000 and 163 000 in 2001. (Additional information relating to residential construction can be obtained on the Internet at www.cmhc-schl.gc.ca.) Non-residential construction, mainly based on gains in institutional building permits, is expected to be greater in 2003.

Energy management in the cement industry will continue to concentrate on gains in efficiency based on timely switching among the available choices of common fuels. However, most longer-term cost savings are expected to result from the partial substitution of fossil fuels by waste-derived fuels. For example, in selected regions, in the case of Refuse Derived Fuel (RDF), about 70% (by volume) of municipal solid waste from post-recycled curbside garbage could be extracted for use by the cement industry. This would reduce by about two thirds the volume of material for disposal as landfill. Under certain circumstances using RDF, reductions in requirements for traditional fuels have been predicted to be as high as 20-25%.

World production and use of cement in 2002 was estimated to be 1.72 billion t, according to the USGS. These amounts are forecast to be about 1.9 billion t and 2.1 billion t in 2005 and 2010, respectively, according to a report by Ocean Shipping Consultants Ltd. Of the overall forecasted 500-Mt increase, accepting the 1999 base-year amount of 1.6 billion t by the USGS, Asia is expected to account for more than 60%, Africa and the Middle East for 13%, and Central and South America for about 10%.

The use of supplementary cementing materials incorporating fly ash, silica fume or other pozzolanic materials such as ground, granulated slags as a partial replacement for energy-intensive Portland cement is expected to become more important in modern cement and concrete practices. An estimated 35-40 Mt of these products are currently used as a raw material or as partial replacement for Portland cement in North America and western Europe.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of February 1, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

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TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
25.23	Portland cement, aluminous cement, slag cement, supersulphate cement and similar hydraulic cements, whether or not coloured or in the form of clinkers				
2523.10	Cement clinkers	Free	Free	Free	Free
	Portland cement:				
2523.21	White cement, whether or not artificially coloured	Free	Free	Free	Free
2523.29	Other	Free	Free	Free	Free
2523.30	Aluminous cement	Free	Free	Free	Free
2523.90	Other hydraulic cements	Free	Free	Free	Free
68.10	Articles of cement, of concrete or of artificial stone, whether or not reinforced				
	Tiles, flagstones, bricks and similar articles:				
6810.11	Building blocks and bricks	3%	Free	Free	Free
6810.19	Other	5%	Free	Free	Free
6810.91	Prefabricated structural components for building or civil engineering	5%	Free	Free	Free
6810.99	Other				
6810.99.10	Pipes	5%	Free	Free	Free
6810.99.90	Other	5%	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003.

TABLE 1. CANADA, CEMENT PRODUCTION AND TRADE, 2000-02

Item No.		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (1) (all forms)							
	Newfoundland and Labrador	x	x	–	–	–	–
	Nova Scotia	x	x	x	x	x	x
	Quebec	2 830 381	240 549	2 888 331	286 668	3 062 875	293 503
	Ontario	5 344 406	507 182	5 695 905	545 348	5 615 395	552 438
	Alberta	x	x	x	x	x	x
	British Columbia	1 919 187	201 443	2 111 380	232 156	2 210 416	247 581
	Total	12 611 954	1 258 697	12 985 521	1 348 313	13 201 488	1 387 497
IMPORTS (2)							
2523.10	Cement clinker						
	Turkey	163 339	6 848	245 399	8 679	44 610	1 784
	United States	624	25	39	2	9 293	377
	Cyprus	–	–	1 500	95	424	16
	Mexico	5 539	247	–	–	–	–
	Spain	62 522	2 866	–	–	–	–
	Switzerland	34 629	2 088	–	–	–	–
	United Arab Emirates	95 951	5 086	–	–	–	–
	Total	362 604	17 162	246 938	8 776	54 327	2 177
2523.21	Portland cement, white, whether or not artificially coloured						
	United States	(r) 14 298	3 098	10 092	1 447	11 929	1 334
	Turkey	13	2	50	10	250	51
	Denmark	5 157	715	3 165	469	128	42
	Mexico	1 141	216	20	6	–	–
	Other countries	68	(r) 12	391	65	51	11
	Total	(r) 20 677	(r) 4 043	13 718	1 997	12 358	1 438
2523.29	Portland cement, n.e.s.						
	United States	506 007	42 171	554 710	47 038	603 481	50 725
	China	–	–	2	...	15 275	1 577
	Peru	–	–	–	–	6 613	549
	Thailand	1	...	–	–	3 464	369
	Croatia	–	–	654	64	1 131	90
	United Kingdom	570	55	1 013	65	705	56
	South Africa	–	–	20	2	242	25
	France	2	...	654	53	387	22
	Mexico	593	54	12 586	1 324	1	...
	Venezuela	–	–	13 097	1 338	–	–
	Other countries	144	12	113	8	330	36
	Total	507 317	42 292	582 849	49 892	631 629	53 449
2523.30	Aluminous cement						
	United States	12 581	7 700	9 670	6 485	11 086	7 513
	Croatia	1 689	1 014	2 531	1 657	2 387	1 599
	Netherlands	–	–	–	–	439	279
	United Kingdom	–	–	–	–	120	60
	Other countries	1	...	5	1	10	5
	Total	14 271	8 714	12 206	8 143	14 042	9 456
2523.90	Hydraulic cement, n.e.s.						
	United States	56 784	6 368	69 585	7 706	70 687	8 444
	Turkey	–	–	41 825	3 150	35 000	1 927
	China	19 927	2 071	20 588	2 189	10 446	1 140
	United Kingdom	3 098	597	3 029	703	3 301	527
	Croatia	692	131	1 270	254	1 864	414
	Thailand	–	–	274	29	1 887	213
	South Africa	199	44	–	–	166	58
	Denmark	–	–	1	...	282	57
	Germany	161	43	521	154	99	30
	Japan	356	108	13	4	118	29
	Belgium	17 867	1 987	11 851	1 149	3	...
	Other countries	(r) 830	175	1 704	269	350	73
	Total	(r) 99 914	11 524	150 661	15 607	124 203	12 912
		(n.a.)	**($000)**	**(n.a.)**	**($000)**	**(n.a.)**	**($000)**
6810.11	Building blocks and bricks of cement, concrete or artificial stone						
	United States	..	(r) 2 929	..	2 914	..	2 949
	Mexico	..	6	–	–	..	23
	Canada	–	–	..	7	..	13
	Brazil	..	219	..	372	..	4
	Other countries	..	42	..	59	..	5
	Total	..	(r) 3 196	..	3 352	..	2 994

TABLE 1 (cont'd)

Item No.		2000		2001		2002 (p)	
		(n.a.)	($000)	(n.a.)	($000)	(n.a.)	($000)
IMPORTS (cont'd)							
6810.19	Tiles, flagstones and similar articles of cement/concrete or artificial stone						
	United States	. .	17 020	. .	19 216	. .	20 822
	Italy	. .	1 105	. .	1 434	. .	1 322
	Mexico	. .	24	. .	704	. .	534
	Spain	. .	(r) 178	. .	140	. .	425
	Portugal	. .	139	. .	133	. .	197
	China	. .	41	. .	52	. .	183
	Czech Republic	–	–	. .	1	. .	171
	Other countries	. .	128	. .	60	. .	246
	Total	. .	(r) 18 635	. .	21 740	. .	23 900
6810.91	Prefabricated structural components of buildings, etc., of cement/concrete, etc.						
	United States	. .	2 507	. .	4 566	. .	4 745
	Malaysia	–	–	–	–	. .	559
	Netherlands	–	–	. .	52	. .	101
	Other countries	. .	1	. .	1	. .	4
	Total	. .	2 508	. .	4 619	. .	5 409
6810.99	Articles of cement, of concrete or of artificial stone, n.e.s.						
	United States	. .	19 840	. .	17 436	. .	15 477
	China	. .	(r) 6 094	. .	6 431	. .	6 554
	Mexico	. .	(r) 935	. .	649	. .	1 747
	Germany	. .	208	. .	148	. .	738
	Spain	. .	54	. .	299	. .	253
	Philippines	. .	(r) 87	. .	77	. .	138
	Hong Kong	. .	28	. .	11	. .	116
	United Kingdom	. .	788	. .	392	. .	90
	Other countries	. .	1 721	. .	1 034	. .	373
	Total	. .	(r) 29 755	. .	26 477	. .	25 486
		(tonnes)	**($000)**	**(tonnes)**	**($000)**	**(tonnes)**	**($000)**
EXPORTS							
2523.10	Cement clinker						
	United States	805 870	64 224	660 913	55 591	680 487	60 290
	Vietnam	–	–	–	–	60	4
	Total	805 870	64 224	660 913	55 591	680 547	60 294
2523.21	Portland cement, white, whether or not artificially coloured						
	United States	180 730	32 480	212 937	40 667	219 387	44 306
	Other countries	29	42	–	–	18	11
	Total	180 759	32 522	212 937	40 667	219 405	44 317
2523.29	Portland cement, n.e.s.						
	United States	3 915 840	310 692	4 160 240	349 589	4 093 040	358 212
	Other countries	30	30	28	17	519	137
	Total	3 915 870	310 722	4 160 268	349 606	4 093 559	358 349
2523.30	Aluminous cement	–	–	–	–	–	–
2523.90	Hydraulic cement, n.e.s.						
	United States	4 404	2 074	87 759	9 042	131 862	18 919
	Hong Kong	20	37	365	96	460	144
	Jamaica	427	217	57	41	150	131
	Czech Republic	16	4	5	4	164	114
	China	20	7	2	2	132	98
	Ukraine	–	–	–	–	102	70
	Poland	–	–	–	–	108	69
	South Korea	–	–	–	–	114	63
	Dominican Republic	–	–	–	–	22	60
	Romania	–	–	–	–	78	55
	Japan	16	9	55	39	52	47
	Singapore	23	23	136	59	17	41
	United Kingdom	1	3	15	16	1 150	15
	Other countries	263	140	290	117	980	152
	Total	5 190	2 514	88 684	9 416	135 391	19 978

TABLE 1 (cont'd)

Item No.		2000		2001		2002 (p)	
		(n.a.)	($000)	(n.a.)	($000)	(n.a.)	($000)
EXPORTS (cont'd)							
6810.11	Building blocks and bricks of cement, concrete or artificial stone						
	United States	. .	64 997	. .	63 897	. .	74 237
	Japan	. .	102	. .	25	. .	183
	South Africa	–	–	. .	245	. .	13
	Other countries	. .	363	. .	328	. .	20
	Total	. .	65 452	. .	64 495	. .	74 453
6810.19	Tiles, flagstones and similar articles of cement/concrete or artificial stone						
	United States	. .	55 021	. .	56 234	. .	59 121
	South Korea	. .	16	–	–	. .	167
	Switzerland	–	–	–	–	. .	115
	Cuba	. .	119	. .	209	. .	85
	Greece	–	–	–	–	. .	79
	United Kingdom	–	–	. .	54	. .	71
	France	. .	34	. .	128	. .	61
	Japan	. .	606	. .	299	. .	47
	Belgium	. .	131	. .	90	. .	44
	Turkey	. .	1 871	. .	1 074	–	–
	Other countries	. .	18	. .	471	. .	164
	Total	. .	57 816	. .	58 559	. .	59 954
6810.91	Prefabricated structural components of buildings, etc., of cement/concrete, etc.						
	United States	. .	96 852	. .	129 746	. .	119 768
	Japan	. .	16	. .	11	. .	166
	Venezuela	. .	192	–	–	. .	125
	United Kingdom	. .	802	. .	2 806	. .	37
	Bermuda	. .	44	. .	285	. .	32
	France	. .	252	. .	30	. .	5
	Other countries	. .	225	. .	356	. .	50
	Total	. .	98 383	. .	133 234	. .	120 182
6810.99	Articles of cement, of concrete or of artificial stone, n.e.s.						
	United States	. .	71 139	. .	69 335	. .	80 951
	France	. .	515	. .	226	. .	180
	Cuba	. .	1 208	. .	430	. .	94
	Japan	. .	83	. .	129	. .	59
	South Korea	. .	99	. .	112	. .	55
	Norway	–	–	. .	82	. .	22
	Bahamas	–	–	–	–	. .	14
	Italy	. .	79	. .	14	. .	7
	Belgium	. .	279	–	–	–	–
	Bermuda	. .	223	. .	211	–	–
	Other countries	. .	377	. .	245	–	–
	Total	. .	74 002	. .	70 784	. .	81 382

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.a. Not applicable; n.e.s. Not elsewhere specified; (p) Preliminary (r) Revised; x Confidential.
(1) Producers' shipments plus quantities used by producers. (2) Includes re-imports.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CEMENT PLANTS, APPROXIMATE ANNUAL GRINDING CAPACITY, END OF 2001

Company	Plant	Wet (W) Dry (D) Preheater (x) Precalciner (c)	Fuel (Coal, Oil, Gas, Waste)	No. of Kilns	Grinding Capacity	Clinker Capacity
					(000 t/y)	
ATLANTIC REGION						
Lafarge Canada Inc.	Brookfield, N.S.	D	C,Wa	2	306	(a) 481
Subtotal, Atlantic region				2	306	481
QUEBEC						
Lafarge Canada Inc.	St. Constant	D	Wa,C,O,G	2	991	970
Ciment Québec Inc. (50% Essroc Gp.; 50% private)	St. Basile	Dc	C,O,G,Wa	1	1 571	821
St. Lawrence Cement Inc. (Holcim (AG) (1)	Joliette	D	C,Wa	4	1 475	900
Subtotal, Quebec region				7	4 037	2 691
ONTARIO						
Lafarge Canada Inc.	Woodstock	W	C,G	2	616	544
	Bath	Dx	C,G	1	1 030	977
Federal White Cement Ltd.	Woodstock	Dx	O,C,G	2	544	929
Essroc Canada Inc. (Italcimenti)	Picton	D,Dx	C,G	2	792	1 116
St. Lawrence Cement Inc. (Holcim AG) (1)	Mississauga	W,Dc	C,Wa	3	2 009	(b) 1 883
St. Marys Cement (Canada) Inc.	Bowmanville	Dc	C	1	1 143	1 972
(Votorantim Cimentos)	St. Marys	Dx	C,Wa	1	820	732
Subtotal, Ontario region				12	6 954	8 153
PRAIRIE REGION						
Lafarge Canada Inc.	Exshaw, Alta.	D,Dc	G	2	1 348	1 199
Lehigh Inland Cement Limited (Heidelberg Cement Group)	Edmonton, Alta.	Dc	G	1	1 380	961
Subtotal, Prairie region				3	2 728	2 160
BRITISH COLUMBIA						
Lafarge Canada Inc.	Kamloops	D	C,G	1	169	209
	Richmond	Dc	C,G	1	896	975
Lehigh Northwest Cement Limited (Heidelberg Cement Group)	Delta	Dx	C,O,G,Wa	1	1 100	1 168
Subtotal, B.C. region				3	2 165	2 352
Total Canada (7 companies, based on ownership)				27	16 190	15 837

Source: Market and Economic Research Department, Portland Cement Association.
(a) One kiln inactive. (b) Two kilns inactive.
(1) Name changed in 2001 from Holderbank Financiere Glaris (Switzerland) AG.
Note: Total active kiln capacity including white cement is approximately 15.1 Mt/y.

TABLE 3. CANADA, CEMENT PLANTS, KILNS AND CAPACITY UTILIZATION, 1980-2002

	Clinker-Producing Plants	Kilns (a)	Approximate Cement Grinding Capacity	Portland and Masonry Cement Production (1)	Clinker Exports (2)	Approximate Total Production (3)	Capacity Utilization
			(t/y)	(t)	(t)	(t)	(%)
1980	23	47	16 363 000	10 274 000	726 087	11 000 087	67
1981	23	48	16 771 000	10 145 000	524 006	10 669 006	64
1982	23	48	16 771 000	8 418 000	290 329	8 708 329	50
1983	23	49	17 900 000	7 870 878	404 793	8 275 671	46
1984	23	49	17 900 000	9 387 466	440 297	9 827 763	55
1985	23	49	17 900 000	10 192 442	676 596	10 869 038	61
1986	23	49	17 900 000	10 611 223	324 000	10 935 223	61
1987	20	40	16 600 000	12 603 164	767 338	13 370 502	81
1988	20	40	15 506 000	12 349 873	331 796	12 681 669	82
1989	20	38	15 546 000	12 590 637	178 491	12 769 128	82
1990	20	38	16 439 000	11 745 152	460 075	12 205 227	74
1991	20	34	16 262 000	9 372 219	544 870	9 917 089	61
1992	18	34	16 800 000	8 593 399	988 348	9 581 747	57
1993	18	34	16 800 000	9 393 581	882 935	10 276 516	61
1994	18	34	(r) 17 021 000	10 584 414	981 024	11 565 438	68
1995	18	34	(r) 16 157 000	10 440 329	1 329 548	11 769 877	69
1996	18	32	16 252 000	11 587 365	1 252 863	12 840 228	79
1997	17	30	15 856 000	11 736 272	1 019 308	12 755 580	80
1998	17	28	15 837 000	12 124 058	1 657 808	13 781 866	87
1999	17	27	16 269 000	12 634 440	1 236 860	13 871 300	85
2000	16	27	17 605 000	12 611 954	805 870	13 417 824	76
2001	16	27	16 190 000	12 985 521	660 913	13 646 434	84
2002 (p)	16	27	16 190 000	13 201 488	680 547	13 882 035	86

Sources: Statistics Canada; Portland Cement Association.
(p) Preliminary; (r) Revised.
(a) May include up to three inactive kilns beginning in 1992.
(1) Producers' shipments and amounts used by producers, including cement ground from imported clinker. (2) Based on Trade of Canada harmonized system code H.S. 2523.10. (3) Producers' shipments plus clinker exports.

TABLE 4. CANADA, PRODUCTION AND USE OF COAL COMBUSTION PRODUCTS (CCPs), 2002(1,2)

	Fly Ash	Bottom Ash	FGD Gypsum	Other (3)	Total CCPs
		(000 tonnes)			
PRODUCTION					
Produced	4 744	1 886	354	133	7 116
Disposed/stored	3 851	1 664	–	133	5 648
Removed from disposal	10	3	–	–	13
USE (DOMESTIC)					
Cement	382	161	–	–	543
Concrete/grout	423	–	–	–	423
Mining applications	115	–	–	–	115
Roadbase/subbase	8	23	–	–	31
Wallboard	–	–	504	–	504
Other (4)	90	52	–	–	142
Total use	1 017	236	504	–	1 757
Individual use percentage	21	13	142	–	n.a.
Cumulative use percentage	21	19	25	25	25

Sources: Compiled by Natural Resources Canada in cooperation with the Canadian Electricity Association and Canadian Industries Recycling Coal Ash (CIRCA).
– Nil; n.a. Not applicable; FGD Flue-gas desulphurization.
(1) Reported production of coal combustion products (CCPs) may include both dry and ponded categories. (2) Use (domestic), as reported, includes amounts imported (assumed HS codes 2621.00 relating to fly ash and HS 2520.10 relating to gypsum). (3) Cfb (circulating fluidized bed) fly ash and bottom ash. (4) Includes waste stabilization and specialty uses such as mineral filler and flowable fill.

TABLE 5. CANADA, VALUE OF CONSTRUCTION BY TYPE, 1996-2002

	1996	1997	1998	1999	2000	2001	2002
				($ billions)			
BUILDING CONSTRUCTION							
Residential investment	32.3	36.5	36.0	38.8	40.8	43.6	55.1
Non-residential building investment	19.6	22.5	22.4	24.2	25.3	26.3	24.8
Total building construction	51.9	59.0	58.4	63.0	66.1	69.9	79.9
ENGINEERING CONSTRUCTION							
Mining and oil and gas extraction	13.9	18.2	16.7	15.4	19.3	21.1	19.1
Transportation and warehousing	2.0	2.2	5.0	5.0	4.1	3.4	3.2
Other engineering	15.2	14.7	14.5	16.6	18.3	18.9	19.1
Total engineering construction	31.1	35.1	36.2	37.0	41.7	43.4	41.4
Total all components	83.0	94.1	94.6	100.0	107.8	113.3	121.3

Sources: Natural Resources Canada; Statistics Canada, CANSIM II (Table 026-0013 – Residential Values, by Type of Investment and Related Table 031-0002 – Flows and Stocks of Fixed Non-Residential Capital, by North American Industry Classification System). (More information can be obtained on the Internet at the CANSIM II site at www.statcan.ca/english/ads/cansimII.)

Notes: Numbers may not add to totals due to rounding. Residential construction includes value of new construction, renovations and acquisition costs.

TABLE 6. WORLD PRODUCTION OF CEMENT, 2001 AND 2002(e)

	2001	2002 (e)
	(000 tonnes)	
Canada	12 986	13 200
Brazil	39 500	40 000
China	626 500	640 000
Germany	28 034	28 000
India	100 000	100 000
Indonesia	31 100	32 000
Italy	39 804	39 000
Japan	76 550	75 000
South Korea	52 012	53 000
Mexico	29 966	30 000
Russia	35 100	39 000
Spain	40 512	40 000
Thailand	27 913	28 000
Turkey	30 120	31 000
United States	90 450	90 600
Other countries	439 611	442 000
Total world	1 700 158	1 720 800

Sources: Natural Resources Canada; U.S. Geological Survey, January 2002.

(e) Estimated.

Chrysotile

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SUMMARY

As a result of fierce competition for market shares by other world producers and a contraction in demand following the adoption of regulatory restrictions by a number of countries, Canadian chrysotile shipments decreased by 13.1% in 2002 compared to the previous year. Total shipments for 2002 are estimated at 240 500 t valued at $98.0 million, compared to revised shipment figures for 2001 of 276 790 t valued at $118.7 million. Canadian exports of chrysotile in 2002 are estimated at 235 138 t, which represents a 13.7% decrease in volume from the previous year. However, the value of these exports only decreased by 8.5% to $140.2 million.

Since the closure of the Baie Verte, Newfoundland, operation in 1994, the Canadian chrysotile industry is concentrated in Quebec. Production comes from three mines: the Black Lake open-pit and Bell underground mines operated by LAB Chrysotile, Inc. near Thetford Mines and the Jeffrey mine operated by Jeffrey Mine Inc. located on the outskirts of the town of Asbestos. This industry provides nearly 4000 direct and indirect jobs to these two communities. The asbestos product manufacturing industry (friction materials, gaskets, roofing products and textiles) is the source of 1000 jobs in 15 businesses. Some of these businesses are found in Ontario and Manitoba, but the majority are located in Quebec.

The world's production of chrysotile is believed to have decreased by about 1.0% to reach 1.97 Mt in 2002. This decrease is mostly attributable to the closure of production capacity in South Africa and the United States and to reduced production in Canada. Production in other countries such as Kazakhstan, Russia, Brazil and Zimbabwe is expected to have remained stable at 2001 levels.

As a consequence of the European ban movement, related regulatory changes in other countries, and the impact of the Asian financial crisis where economies are still recovering in some cases, worldwide chrysotile asbestos use will remain low in coming years compared to that of the mid-1990s. However, the general strengthening of the global economy in 2003 and the gradual recognition by regulatory bodies of the potential toxicity of the main substitute fibres may help stabilize worldwide chrysotile use in the medium term.

CHRYSOTILE AND ITS USES

Chrysotile (a natural fibrous hydrated silicate) is the only form of asbestos in the serpentine group. Crocidolite, amosite, anthophyllite, actinolite and tremolite form the amphibole group. Of these minerals, chrysotile is the least hazardous to human health and is the only one extracted in Canada. Chrysotile, which is sensitive to acid, tends to dissolve in the lungs unless these are overburdened from exposure to excessive levels in the occupational environment. All fibres (asbestos or substitutes) that enter the lungs cause mechanical irritation. In the past, most of the problems associated with chrysotile have been due to the poor working practices that existed then in both the handling and use of chrysotile. With the marked improvements in today's work practices and the increased protection of workers, the occupational risks associated with chrysotile have been tremendously reduced and are controllable with existing technology.

Because of their chemical and physical properties, chrysotile fibres are an extremely useful material that has been, and still is being, widely used throughout the world. In Canada, chrysotile fibres are classified into seven groups, each with its own sub-categories, with the longest fibres assigned to Group 1 and the shortest to Group 7. In decreasing length, chrysotile has been used in textiles, clothing, packings, woven brake linings, clutch facings, electrical insulation materials, high-pressure and marine insulation, asbestos-cement pipe, other asbestos-cement products (e.g., sheets and mouldings, shingles, extrusions), gaskets, paper products, vinyl sheet backings, and millboards. The shortest fibres (Group 7) are used in moulded brake linings and as a filler in cement, plastics, roof coatings and caulking compounds. Some 90% of all chrysotile produced globally is used in asbestos-cement products such as pipes, plates and corrugated sheets; 7% is used in friction products such as brake linings and clutch facings; and 3% is used in textiles, clothing and various other uses. Low-density and friable products are no longer marketed and are prohibited in Canada under the *Hazardous Products Act*.

CANADIAN DEVELOPMENTS

On June 20, 2002, the Government of Quebec adopted a policy for the increased and safe use of chrysotile asbestos. This policy, aimed at silencing critics who accuse Quebec of producing chrysotile only for export, will enable Quebec to set an example and showcase to the world how to use the fibre safely. In fact, while Quebec only uses about 2-3% of its production, its current use per capita (1 kg/person) is about equal to that of other producers such as Brazil, but lower than Russia's (2.8 kg/person). Products targeted for greater use in Quebec include chrysotile-cement pressure pipes, structural tube support for lighting purposes, fireproof paper for archiving, chrysotile-reinforced plastics, and chrysotile asphalt. This latter product has been used successfully in Quebec over the past few years and has proven its cost benefit advantages. Quebec used about 120 000 t of chrysotile asphalt in 2001.

Production

As a result of financial pressure put on it by plummeting market demand and the costs associated with the development of an underground operation to extend the life of its mine, Jeffrey Mine Inc. filed for bankruptcy protection under the *Companies' Creditors Arrangement Act* on October 7, 2002, to enable it to develop a settlement plan with its creditors. Slated to gradually replace production from the open pit over a period of 12 months, the underground mine is designed to have a maximum capacity of 250 000 t/y of chrysotile fibre until 2020. The capital cost of this development, estimated to be $133 million, is financed from the operation's cash flows and from a $65 million loan of which 70% was guaranteed by the Quebec government in October 1998 through "Investissement Québec." Jeffrey Mine Inc. has already invested $68 million in the project.

However, the permanent closing of the Jeffrey mine was postponed following the United States' National Aeronautics and Space Administration (NASA) space shuttle program offer of a multi-million-dollar contract, through ATK Thiokol Propulsion, for the supply of a special chrysotile fibre needed to manufacture thermal insulant for the space shuttle's solid rocket boosters. Ever since the maiden launch of space shuttle Columbia in 1981, the Jeffrey mine has supplied material for the two giant solid-fuel reusable rocket motors that boost each shuttle into orbit. The asbestos fibres protect the rockets' case from the burning fuel during liftoff. The NASA contract will enable the Jeffrey mine to treat ore stockpiled at the mine to produce about 40 000 t of chrysotile fibres, including about 590 t of the high-grade fibre "plastibest" for NASA, enough to supply the shuttle's solid-fuel rocket systems until 2020. For this purpose, 250 of the 320 former workers at the Jeffrey mine were recalled for about four months starting on December 2, 2002. The Jeffrey mine's closure would have forced NASA and ATK to switch to another chrysotile asbestos supplier and would have required years of extensive testing, such as building full-scale motors for field tests, before the material was certified again as safe for human spaceflight by NASA.

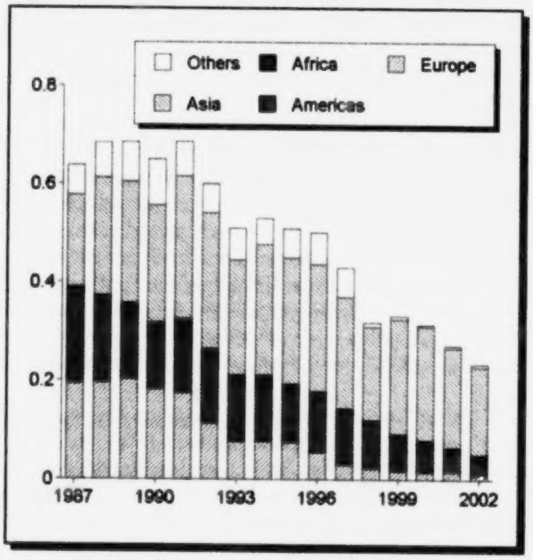
In 2002, because of periodic shut-downs of operations and temporary layoffs throughout the year, Jeffrey Mine Inc.'s production level decreased to 92 493 t, compared to 125 152 t in the previous year.

Pressured by markets to make up for the drop in supply brought about by the extensive shut-down at the Jeffrey mine during the year, LAB Chrysotile, Inc. (the largest Canadian chrysotile producer) increased its production level. However, hampered by a seven-month lockout at its Black Lake open-pit operation that started on April 28, 2002, the company had to make up the balance by drawing from inventories accumulated in 2001. Because of this, LAB Chrysotile's production in 2002 only reached 149 728 t, a drop of 1.3% compared to 2001. The company pursued its $40 million slope stabilization project at its Black Lake operation during the year. Reserves at this site are sufficient for the next 13 years at current production rates.

Trade

Asian countries are still the main markets for Canadian fibres, accounting for about 75% of Canadian exports. In 2002, exports to Asian countries decreased by 12% compared to 2001 on account of significant drops in exports to Japan and Hong Kong. Pursuing the trend established in recent years, India remained Canada's preferred export destination during 2002 although its imports were 8.0% lower than in 2001. Use in India is nonetheless expected to remain strong in the short and medium term, mainly due to increased demand for infrastructure development, but fierce competition from India's iron and steel industry may limit the growth in demand for chrysotile-cement products. Moving in the opposite direction, exports to Japan dropped by 78% during the same period. This was brought about by the depressed state of the Japanese economy and by the gradual move of its manufacturing industry to substitute materials. In doing so, it relinquished its position as Canada's second most important shipping destination to Thailand, where exports increased by 18% in 2002 to reach close to 41 000 t. Similarly, Canada's

Figure 1
Canadian Chrysotile Exports, 1987-2002



Sources: Natural Resources Canada; Statistics Canada.

exports to China, Pakistan, Vietnam and Bangladesh increased while those to Indonesia, South Korea, Malaysia, Sri Lanka and Taiwan decreased.

In Europe (which still accounts for close to 4% of Canada's exports), the gradual compliance of countries to the European Union ban decision on chrysotile use led to a 49% drop in Canada's exports to the area in 2002 compared to 2001. The drastic change in demand registered during the year stems from Spain's gradual switch to substitute fibres. Further decreases are still expected in the coming years as Portugal, the last remaining European country not to have restricted the use of chrysotile, reluctantly complies with the EU ban directive by 2005.

Influenced by tendencies in Europe and under corporate pressure to substitute chrysotile asbestos (an important percentage of Latin American chrysotile-using companies being subsidiaries of multinational companies headquartered in Belgium and France), the Americas decreased its relative position as an important destination for Canadian chrysotile in 2002, accounting for just under 13% of Canada's exports. In 2002, exports to Mexico decreased by 64% to 7300 t compared to 2001, partly as a result of the country's shift in use to substitutes and increased imports from Brazil. However, reversing a turn to Russian imports that started in 1997, Cuban chrysotile imports from Canada shot to nearly 2700 t in 2002 from close to nil in 2001. Cuban imports from Canada are expected to increase in the short term, making Cuba an important destination for Canadian chrysotile. Exports to the United States during the year pursued their slow decrease, falling to slightly more than 6600 t compared to more than 10 500 t in 2001. However, exports are expected to soon reach a base level where they will stabilize for the coming years given that the remaining uses for chrysotile are more difficult to substitute. For reasons similar to the ones mentioned above, Canadian chrysotile exports to Argentina, Brazil, Colombia, the Dominican Republic, Ecuador, Panama, Peru and Venezuela decreased compared to 2001. Other than that mentioned above, the only significant increase in imports reported were from El Salvador (20%).

In Africa, Canadian exports in 2002 improved significantly and reached more than 12 500 t, compared to a level of slightly more than 7750 t in 2001. This was essentially achieved through higher exports to Algeria, Angola, Morocco and Senegal, whereas exports to Nigeria fell significantly. Canadian exports to the Middle East, mostly to the United Arab Emirates and Iran, increased substantially while those to Egypt dropped. Varying Canadian export levels to African and Middle Eastern countries in recent years are the result of a number of factors such as social unrest, competitive Russian exports to these regions, and the influence of European policy changes.

INTERNATIONAL AND REGULATORY DEVELOPMENTS

The world's production of chrysotile is believed to have decreased by about 1.0% to reach 1.97 Mt in 2002 (see table below). This decrease is mostly attributable to the closure of production capacity in South Africa and the United States and to reduced production in Canada. Production in other countries such as Brazil, Kazakhstan, Russia and Zimbabwe is expected to have remained stable at 2001 levels.

CHRYSOTILE, WORLD PRODUCTION BY COUNTRY, 2002

Country	Tonnes (e)
Russia	750 000
China	360 000
Canada	240 500
Kazakhstan	235 000
Brazil	180 000
Zimbabwe	135 000
India	20 000
South Africa	13 400
Colombia	8 000
United States	3 000
Others	25 000
Total	1 969 900

Sources: Natural Resources Canada; United States Geological Survey.
(e) Estimated.

Taking advantage of the devaluation of their currency and of their low production costs, Brazil, Kazakhstan, Russia and Zimbabwe increased their market shares at the expense of that of Canada.

The Americas

Brazil

Brazil is an important producer of chrysotile asbestos, ranking fifth worldwide. Its sole producer, Sociedade Anonima Mineraçao do Amianto (SAMA), produced approximately 180 000 t in 2002, about 10% less than in 2001. Most of this production – on average 160 000 t – is used by Brazil's chrysotile-cement manufacturing industry while the rest is exported mostly to Latin American countries. SAMA's mine is located at Minaçu in the state of Goiás.

At the regulatory level, two important national Brazilian bodies, the Federal Supreme Court and a House of Representatives Committee, ruled in favour of maintaining the controlled use of chrysotile asbestos in their country. On September 26, 2001, the Brazilian Federal Supreme Court had remanded the law of the state of South Mato Grosso that forbade the manufacture, entry, marketing and storage of all asbestos fibre for civil construction or for products made of asbestos by declaring it unconstitutional. Similar legislation formerly adopted in three other states (Sao Paulo, Rio de Janeiro and Rio Grande do Sul) were all confronted with the same verdict. The federal law in force since 1995 is reconfirmed as applying to all of Brazil. It stipulates health protection and security measures for workers in contact with the product and forbids the use of the most dangerous types of asbestos (amphiboles) by virtue of Convention 162 of the International Labour Organization.

On October 15, 2002, a Brazilian Chrysotile Institute called "Crisotila Brasil" was formed by executives of the mining and fibre cement industry and the partnership of the Secretary of Industry and Commerce of Goiás, the National Department of Mineral Production, the city of Minaçu, and the Union of the Workers of the Non-Metallic Minerals Industry of Minaçu. The purpose of this agency is essentially to promote the safe use of chrysotile by disseminating information on the issue on domestic and international markets, and by stimulating and supporting studies and research related to the safe use of chrysotile fibres and their applications.

Mexico

In 2002, the Instituto Mexicano de Fibro-Industrias, A.C. (IMFI), a member of the Asbestos International Association (AIA) regional program for Latin American countries, the AIA/CLAS (Confederación Latinoamericana del Asbesto), held a conference on May 17, 2002, in collaboration with the Asbestos Institute, to promote the safe use of chrysotile asbestos and assist in the implementation of the industry's responsible use policy. Emphasis was made on the need for better dialogue between industry and governments.

United States

The United States Geological Survey estimated 2002 asbestos fibre imports into the United States at 6849 t, compared to 12 700 t in 2001. Canada remains the largest exporter (97%) of chrysotile to the United States. The only U.S. asbestos producer, King City Asbestos Corporation's New Idria mine near Coalinga, California, closed in 2002 as a result of declining markets for its fibre grade. Shipments from this mine amounted to about 3000 t of chrysotile in 2002, down from about 5260 t in 2001.

In the United States, asbestos is used in roofing products (71%), gaskets (18%), friction products (5%), and other products (6%). Although no longer manufactured in the United States, asbestos-cement pipes are currently being imported from Mexico into the United States where there remains an important demand for this product in southwestern states. The United States' main import based on tonnage is, however, asbestos-cement sheets, panels and tiles while, based on value, its main import is friction products such as brake linings and pads. Total imports of asbestos products in 2002 amounted to about US$556 million, about equal to that in 2001.

U.S. exports of chrysotile fibres, essentially to Japan and Mexico, increased by 34% to 6554 t in 2002. U.S. exports of asbestos-containing products (mostly brake linings, mounted brake linings and other friction products) to several countries, including Australia, Belgium, Canada, Germany, Japan, Mexico, Saudi Arabia, South Korea, the United Kingdom and Venezuela, amounted to about US$205 million, down 32% from 2001.

Asbestos litigation – affecting some 8400 companies – pursued its damaging effect on the U.S. economy during the year by forcing additional companies into bankruptcy. The failings of the U.S. judicial system were made apparent by the fact that most of the claimants involve people that were exposed to asbestos in one way or another but that have not developed a related illness because such claims must be filed before statutory deadlines are reached. The U.S. Congress is under mounting pressure to address the situation, such as having medical criteria established for non-malignant asbestos-related illnesses and exempting potential claimants from statutory deadlines for filing such claims until their condition meets the criteria.

During 2002, the U.S. Environmental Protection Agency (EPA) oversaw the development of a revised methodology for conducting risk assessments of asbestos to take into account the substantial improvements that occurred since 1986 in asbestos measurement techniques and in the understanding of how asbestos exposure contributes to disease. The EPA's current assessment of asbestos toxicity, based primarily on an assessment completed in 1986, considers all mineral forms of asbestos and all asbestos fibre sizes to be of equal carcinogenic potency. However, the proposed risk assessment methodology distinguishes between fibre sizes and fibre types in estimating potential health risks related to asbestos exposure. It incorporates the knowledge gained over the last 17 years into the agency's toxicity assessment for asbestos. The EPA is scheduled to convene a peer consultation workshop in 2003 to seek input from a panel of experts on the scientific merit of the proposed methodology.

Europe

European Commission

During 2002, the European Commission (EC) pursued the phase-in of its asbestos ban directive (1999/77/EC) whereby member states of the European Union must phase out the placing on the market and use of chrysotile asbestos and of products containing this fibre no later than January 1, 2005. However, as stipulated in the directive, because of significant controversy during its development regarding the "relative safety" of substitutes, the EC proceeded in 2002 to review its ban measure as follows: "Whereas the scientific knowledge about asbestos and its substitutes is continually developing; whereas the Commission will therefore ask the Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE) to undertake a further review of any relevant new scientific data on the health risks of chrysotile asbestos and its substitutes before January 1, 2003; whereas this review will also consider other aspects of this directive, in particular the derogations, in the light of technical progress; whereas, if necessary, the Commission will propose appropriate changes to legislation."

As part of this commitment, the SCTEE reviewed all relevant new studies on chrysotile, including preliminary results from a toxicological study on chrysotile showing the lesser biopersistence of this fibre compared to the main substitute fibres. Biopersistence is one of three parameters identifying the potential toxicity of a fibre, the other two being the average dimensions of the fibres (affecting the respirability of the fibre) and the dose or amount of fibres subjects are exposed to. Despite highlighting the lack of epidemiological data on certain substitutes, the SCTEE re-affirmed its conclusions that the main substitutes to chrysotile are likely safer.

At the end of 2002, Portugal was the only European Union country still using chrysotile extensively, but was proceeding to comply with the new directive by the 2005 deadline.

United Kingdom

The implementation in the U.K. on November 24, 1999, of Commission Directive 1999/77/EC prohibiting the use, import and manufacture of chrysotile asbestos brought to the fore the issue of potential health risks associated with in-place asbestos products. To address this issue, the U.K.'s Health and Safety Executive developed a law to force property owners to remove from their buildings all asbestos-based products (even asbestos-cement products such as roof tiles) before being able to sell their properties. However, mounting negative publicity highlighting the significant costs of removing asbestos products compared to the trivial benefits derived forced the U.K. government to review its policy on the matter and postpone its entry into force.

Other Producers

China

Chrysotile asbestos production in China is estimated at 360 000 t in 2002, mostly emanating from the country's western provinces of Xinjiang and Qinghai, and the eastern provinces of Liaoning and Hebei. This production is slated for domestic use in the manufacturing of asbestos-cement products used in the development of the country's infrastructure. Asbestos use in China is expected to keep pace with the increasing construction activity, which may result in an increase in imports.

India

In India, small-scale mining occurs in a number of states, notably in Rajasthan and Bihar, which results in the annual production of about 20 000 t of asbestos. Other than from Canadian and domestic mines, India's asbestos requirements are sourced from Zimbabwe and Russia. Indian use of asbestos is nearly exclusively for the manufacture of asbestos-cement products used by the construction industry such as roofing sheets and pressure pipes for the transport of drinking water. Currently, there are about 75 plants engaged in the production of asbestos products across India. These are mainly located in the states of Gujarat, Karnataka, Madhya Pradesh and Andhra Pradesh.

Kazakhstan

Chrysotile asbestos production in Kazakhstan comes from the Kostanai region where the Joint Stock Combine (JSC) Kostanaiasbest operates the Dzhetygarinsk open-pit mine. Production in 2002 is estimated at 235 000 t, up from a level of about 200 000 t in the previous year. Taking advantage of its lower cost base, the combine has more than doubled its production since 1998 and is even planning additional investments by 2005 to further modernize its operations.

Russia

Russia, the world's largest asbestos producer, is estimated to have produced 750 000 t of chrysotile asbestos in 2002, an increase of 4.4% from 2001. The Russian chrysotile mining industry consists of three companies: JSC Uralasbest, JSC Orenburgasbest, and JSC Tuvaasbest, who operate four open-pit mines located in the Urals (3) and in the Tuva region (1) north of Mongolia. An important portion of the country's production is for domestic use or is transformed before being exported. About 40% is exported as fibre concentrates while the rest is used to manufacture asbestos-cement products (80%) and technical products (20%) such as friction material products, thermal and electric insulation materials, etc.

An international conference on Safety and Health in the Production and Use of Asbestos and Other Fibrous Materials was held in Ekaterinburg in June 2002. Organized by the Russian Asbestos Association in collaboration with the Asbestos Institute, this conference attracted delegates from industry, governments and labour unions of 19 chrysotile-producing and using countries. It was organized to update participants on the state of knowledge on asbestos and substitute fibres and to disseminate information on the safe and responsible use of chrysotile asbestos. During the two days, several speakers made presentations on legislation and regulation requirements, dust surveys in different fibre industries, monitoring for health protection and safety in the use of chrysotile and of other fibrous materials, occupational risk assessment, and the most recent control technology and work practices. The importance of acquiring the cooperation of all stakeholders (employers, government, labour) to ensure the implementation of the safe and responsible use of chrysotile was highlighted.

South Africa

Asbestos production in the Republic of South Africa plummeted to 245 t of chrysotile fibres in 2002 as a result of the closure of the country's mining operations. However, as a result of drawdowns from stockpiles, sales slightly above 13 400 t were recorded, including about 5600 t for exports. Production was provided in recent years by Msauli Asbes Beperk, which operated an underground mine and processing plant in the Barberton area of Mpumalanga, and by Kaapsehoop Asbestos and Stella Asbestos, who both operated smaller mines in the same area as above and supplied the local markets.

Zimbabwe

Despite political and economical instability during the year, chrysotile production at Zimbabwe's Shabanie and Mashaba mines reached about 135 000 t, a production level similar to that of the previous year. The company was also able to keep its sales at the 2001 level, despite lower world use, on account of the devaluation of the country's currency.

Other Developments

Rotterdam Convention

Adopted on September 10, 1998, the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade is a multilateral environmental agreement jointly administered by the United Nations Environment Programme (UNEP) and the Food and Agriculture Organization (FAO) of the United Nations. The objectives of the Convention are:

- to promote shared responsibility and cooperative efforts among participating countries in the international trade of certain hazardous chemicals and pesticides in order to protect human health and the environment from potential harm; and
- to contribute to the environmentally sound use of those hazardous chemicals and pesticides by facilitating information exchange, by providing for a national decision-making process on their import and export, and by disseminating these decisions to participating countries.

This new tool will assist developing countries and countries with economies in transition to better understand and manage the risks associated with the use of toxic chemicals and pesticides. The PIC procedure currently covers 26 pesticides and 5 industrial chemicals referred to as PIC substances. In February 2002, a proposal was made to add all forms of asbestos to the PIC procedure. For this purpose a committee proceeded to draft a Decision Guidance Document (DGD) on asbestos. This document will provide a summary of toxicological and environmental characteristics, known usage, possible exposure routes, measures to reduce exposure, and regulatory actions taken by countries to ban or restrict the use of asbestos. Chrysotile will be described in a separate chapter to distinguish it from other more toxic forms of asbestos. The DGD for asbestos should be completed in March 2003 and submitted for approval to the governing body of the Convention at its meeting in November 2003. If the DGD is accepted, it is expected that chrysotile would be subject to the PIC procedure starting in the Spring of 2004.

Responsible Use Policy

To demonstrate its support for the promotion and implementation of the responsible use policy adopted by the chrysotile producers and exporters of six countries (Brazil, Canada, South Africa, Swaziland, Zimbabwe and Russia, the latter of which signed on February 3, 2000), the Canadian government signed, on March 3, 1997, a memorandum of understanding (MOU) in support of the responsible use policy with Canadian chrysotile producers. This MOU commits the government to assist the industry in encouraging the governments of asbestos-using countries to endorse the responsible use policy and to develop appropriate regulations where they do not already exist.

The responsible use policy, a voluntary industry policy aimed at increasing workers' protection worldwide, resulted from a 1994 meeting and was signed in late 1995/early 1996. The ultimate objective of this policy, known as the "Responsible Use of Chrysotile," is to supply chrysotile only to those users that are in compliance with their respective national regulations or that have submitted a written commitment with an action plan in order to be in full compliance with their national regulations. The responsible use policy is based on the recognition and acceptance of the principles of the 1986 International Labour Organization Convention 162 and Code of Practice on Safety in the Use of Asbestos.

Acting on a conclusion of the International Conference on the Safe and Responsible Use of Chrysotile Fibres held in Montréal on September 16-19, 1997, that "chrysotile producers should export their technology and their expertise with their fibre," the Asbestos Institute in 2002 met with or travelled to half a dozen countries to either: 1) hold information seminars and/or training sessions; 2) meet government and industry officials; or 3) visit manufacturing plants to promote the safe use of chrysotile.

Developed by the Asbestos Institute in cooperation with labour and the governments of Canada and Quebec, the program, which began in October 1997, is aimed at providing Canadian expertise to train workers in targeted chrysotile-using countries in order to increase their knowledge of safe and responsible chrysotile asbestos manufacturing techniques. Supported by Natural Resources Canada and by the Economic Development Agency of Canada for the Regions of Quebec, this training program promotes the International Labour Organization's Convention 162 on Safety in the Use of Asbestos.

Activities for the promotion of the safe use of chrysotile planned for 2003 include visits to half a dozen chrysotile-using countries.

OUTLOOK

Lower demand brought about by the European asbestos ban – and the impact it has on influencing legislation changes in other chrysotile-using countries – is expected to be partly counterbalanced by recovering Asian markets and to result in worldwide chrysotile use decreasing slightly relative to the 2002 level. Markets should experience a further resumption in demand in coming years as Asian economies gradually gain strength. More specifically, use in India and China is expected to remain strong in the short and medium term due to increased demand for infrastructure development, while demand from Japan is expected to gradually decrease as its manufacturing industry turns to substitute materials. A further decrease in use is still expected in the coming years in Europe as Portugal complies with the EU ban directive by the year 2005. Demand from the Americas overall should be stable at the 2002 level as lower U.S. use is counterbalanced by increases in Argentina, Brazil and Peru. Similarly, use on the African subcontinent should remain at current levels in the short term.

In developing countries, the benefits and safety of chrysotile-cement products continue to be recognized despite increasing competition from substitute fibres, PVC and galvanized steel. In particular, chrysotile-cement pipes are essential to the distribution of potable water and irrigation in many countries where aggressive soils and economic conditions are not appropriate for substitute products.

The aggressive introduction of new chrysotile-containing products to address current health concerns and the gradual recognition by regulatory bodies of the potential toxicity of the main substitute fibres may help turn chrysotile asbestos markets around in the medium term.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of January 1, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2524.00.10	Crude asbestos	Free	Free	Free	Free
2524.00.90	Other asbestos	Free	Free	Free	Free
6811.10	Corrugated sheets of asbestos-cement, of cellulose fibre-cement or the like	5%	Free	Free	Free
6811.20	Sheets, panels/tiles, etc., of asbestos-cement, cellulose fibre-cement, etc.	5%	Free	Free	Free
6811.30	Tubes, pipes, and tube or pipe fittings of asbestos-cement, of cellulose fibre-cement, etc.	5%	Free	Free	Free
6811.90	Other articles of asbestos-cement, of cellulose fibre-cement, or the like	5%	Free	Free	Free
68.12	Fabricated asbestos fibres; mixtures with a basis of asbestos or with a basis of asbestos and magnesium carbonate				
6812.50	Asbestos clothing, clothing accessories, footwear and headgear	15.5%	Free	Free	Free
6812.60	Asbestos paper, millboard and felt	Free	Free	Free	Free
6812.70	Compressed asbestos fibre jointing, in sheets or rolls	Free	Free	Free	Free
6812.90	Other				
6812.90.10	Gaskets	Free	Free	Free	Free
6812.90.20	Fabricated asbestos fibres; mixtures with a basis of asbestos or with a basis of asbestos and magnesium carbonate	Free	Free	Free	Free
6812.90.30	Yarn and thread	Free	Free	Free	Free
6812.90.40	Cords and string, whether or not plaited	Free	Free	Free	Free
6812.90.50	Woven or knitted fabric	Free	Free	Free	Free
6812.90.90	Other	Free	Free	Free	Free
6813.10	Asbestos brake linings and pads				
6813.10.10	For motor vehicles of heading 87.02, 87.03, 87.04 or 87.05	7%	Free	Free	Free
6813.10.90	Other asbestos brake linings and pads	5%	5%	Free	Free
6813.90.10	Clutch facings for motor vehicles of headings 87.02, 87.03, 87.04 or 87.05	Free	Free	Free	Free
6813.90.90	Other asbestos friction material and articles thereof	Free	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States,* 2003.

TABLE 1. CANADA, ASBESTOS PRODUCTION AND TRADE, 2000-2002

		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (Shipments)							
	By type						
	Group 3, spinning	4 345	4 751	4 173	4 176	4 536	4 454
	Group 4, shingle	62 905	50 271	57 020	42 505	39 871	28 823
	Group 5, paper	62 263	33 319	54 646	26 132	63 142	28 184
	Group 6, stucco	113 752	38 282	100 808	32 986	81 176	25 194
	Group 7, refuse	66 454	15 046	60 143	12 942	51 775	11 345
	Total	309 719	141 670	276 790	118 741	240 500	98 000
	By province						
	Quebec	309 719	141 670	276 790	118 741	240 500	98 000
	British Columbia	–	–	–	–	–	–
	Newfoundland and Labrador	–	–	–	–	–	–
	Total	309 719	141 670	276 790	118 741	240 500	98 000
EXPORTS							
2524.00.10	Crude asbestos						
	United States	3 415	651	2 298	542	1 554	317
	India	–	–	–	–	393	175
	Japan	142	21	–	–	–	–
	Total	3 557	672	2 298	542	1 947	492
2524.00.21	Asbestos milled fibres, group 3 grades						
	EC countries (12)						
	Spain	288	374	54	70	–	–
	Germany	–	–	12	22	–	–
	EC countries, subtotal	288	374	66	92		
	Mexico	1 440	1 869	1 214	1 579	1 196	1 551
	United Arab Emirates	18	23	684	889	840	1 092
	India	571	667	781	1 022	650	853
	Algeria	–	–	130	169	250	325
	China	114	153	163	220	150	202
	Hungary	162	211	162	211	138	181
	Brazil	154	210	155	210	112	153
	Indonesia	200	260	150	195	105	137
	Macedonia	–	–	–	–	75	101
	Other countries	846	1 068	333	385	244	284
	Total	3 793	4 835	3 836	4 972	3 760	4 879
2524.00.22	Asbestos milled fibres, groups 4 and 5 grades						
	EC countries (12)						
	Portugal	1 745	1 629	2 086	2 034	3 664	3 412
	Spain	5 646	5 111	6 542	5 276	1 437	829
	Germany	40	58	32	44	120	117
	United Kingdom	54	39	5	4	24	20
	France	–	–	10	14	–	–
	EC countries, subtotal	7 485	6 837	8 675	7 372	5 245	4 378
	Thailand	18 026	12 956	14 147	9 268	33 001	21 037
	India	26 448	20 048	24 334	17 892	30 951	20 038
	Indonesia	8 401	5 999	10 523	7 209	15 959	10 270
	Japan	22 583	21 872	19 118	18 877	12 452	10 210
	Algeria	720	602	3 160	2 643	8 130	7 404
	Malaysia	6 319	5 211	3 955	3 199	4 193	3 431
	Sri Lanka	4 535	4 302	5 010	4 402	3 032	2 632
	Cuba	660	564	–	–	2 540	2 023
	South Korea	5 434	3 532	2 578	1 756	2 858	2 006
	Mexico	7 323	6 768	4 909	4 061	2 607	1 900
	United Arab Emirates	830	742	958	748	2 226	1 672
	Ecuador	2 910	2 839	1 964	1 820	1 760	1 595
	El Salvador	1 090	913	1 552	1 270	1 814	1 542
	Philippines	790	621	1 240	976	1 529	1 168

TABLE 1 (cont'd)

		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
	Colombia	3 480	3 235	2 584	2 405	1 267	1 044
	Turkey	1 439	984	596	439	1 492	1 000
	Other countries	11 210	9 735	10 223	8 092	8 701	6 031
	Total	129 736	107 760	115 526	92 429	139 757	99 381
2524.00.29	Asbestos shorts, groups 6, 7, 8 and 9 grades						
	EC countries (12)						
	Portugal	954	317	1 414	503	932	367
	Spain	2 299	909	4 639	1 870	211	60
	United Kingdom	86	26	–	–	17	5
	Germany	56	20	88	31	–	–
	EC countries, subtotal	3 395	1 272	6 141	2 404	1 160	432
	India	31 970	12 402	30 445	11 336	19 824	8 466
	Japan	27 855	11 583	24 079	9 909	11 774	5 634
	South Korea	18 270	6 788	16 821	5 837	12 426	4 654
	Thailand	27 068	10 313	19 388	7 308	7 931	3 386
	United States	11 002	2 940	8 137	2 075	4 988	1 792
	Colombia	5 041	2 026	3 995	1 550	4 702	1 665
	Indonesia	14 256	5 163	11 805	4 292	3 802	1 420
	Malaysia	7 652	3 135	5 159	1 942	3 051	1 213
	Sri Lanka	1 809	927	1 720	888	1 780	923
	Mexico	8 902	2 826	5 855	1 760	3 497	919
	Other countries	22 820	7 853	17 111	6 041	14 739	4 945
	Total	178 240	67 228	150 656	55 342	89 674	35 449
Total exports, crude, milled fibres and shorts		315 326	180 495	272 316	153 285	235 138	140 201
6811.10	Corrugated sheets of asbestos-cement, of cellulose fibre-cement, or the like						
	United States	. .	51	–	–	. .	8
6811.20	Sheets n.e.s., panels/tiles, etc., of asbestos-cement, cellulose fibre-cement, etc.						
	United States	. .	17 909	. .	17 401	. .	15 403
	South Korea	–	–	–	–	. .	840
	Portugal	–	–	–	–	. .	46
	Cuba	. .	53	–	–	–	–
	Total	. .	17 962	. .	17 401	. .	16 289
6811.30	Articles of asbestos-cement, of cellulose fibre-cement or the like						
	Tubes, pipes and tube or pipe fittings						
	United States	–	–	–	–	. .	17
	Cuba	–	–	. .	. . .	–	–
	Total	–	–	. .	. . .	. .	17
6811.90	Articles n.e.s. of asbestos-cement, of cellulose fibre-cement, or the like						
	United States	. .	66	. .	43	. .	91
	Jamaica	–	–	–	–	. .	19
	China	. .	19	. .	15	. .	12
	Total	. .	85	. .	58	. .	122
6812.10	Fabricated asbestos fibres; mixtures with a basis of asbestos or with a basis of asbestos and maganesium carbonate	–	–	–	–	–	–

TABLE 1 (cont'd)

		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
6812.20	Asbestos yarn and thread						
	Brazil	39	200	26	270	–	–
	United Kingdom	6	39	11	72	–	–
	Morocco	51	274	13	70	–	–
	Venezuela	69	299	14	58	–	–
	Other countries	17	143	. .	14	–	–
	Total	182	955	64	484	–	–
6812.30	Asbestos cords and string, whether or not plaited						
	Cuba	. .	5	. .	8	–	–
	United States	. .	15	–	–	–	–
	Mexico	–	–	. .	1	–	–
	Total	. .	20	. .	9	–	–
6812.40	Asbestos woven or knitted fabric						
	United Kingdom	54	473	61	590	–	–
	United States	9	165	16	364	–	–
	Morocco	13	68	26	143	–	–
	Venezuela	28	123	8	38	–	–
	Other countries	12	69	1	5	–	–
	Total	116	898	112	1 140	–	–
6812.50	Asbestos clothing, clothing accessories, footwear and headgear						
	Saudi Arabia	. .	15	–	–	. .	110
	Taiwan	–	–	–	–	. .	50
	Other countries	. .	42	. .	41	. .	13
	Total	. .	57	. .	41	. .	173
6812.60	Asbestos paper, millboard and felt						
	Fiji	–	–	–	–	. .	1
	Japan	. .	1	–	–	–	–
	Saint Vincent and the Grenadines	. .	6	. .	1	–	–
	United States	. .	3	. .	9	–	–
	Australia	–	–	. .	1	–	–
	Total	. .	10	. .	11	. .	1
6812.70	Compressed asbestos fibre jointing, in sheets or rolls						
	United States	. .	1 107	. .	1 141	. .	964
	Other countries	. .	338	. .	342	. .	86
	Total	. .	1 445	. .	1 483	. .	1 050
6812.90.10	Asbestos building material, n.e.s.						
	Japan	. .	136	. .	102	. .	497
	Hong Kong	–	–	. .	249	. .	355
	Cuba	–	–	. .	41	. .	168
	United Kingdom	–	–	–	–	. .	94
	Other countries	. .	120	. .	445	. .	448
	Total	. .	256	. .	837	. .	1 562
6812.90.90	Other asbestos fabricated products, n.e.s.						
	United States	. .	74	. .	389	. .	311
	Other countries	. .	124	. .	16	. .	25
	Total	. .	198	. .	405	. .	336

TABLE 1 (cont'd)

		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
6813.10	Asbestos brake linings and pads						
	United States	. .	58 308	. .	71 500	. .	87 145
	Other countries	. .	247	. .	133	. .	213
	Total	. .	58 555	. .	71 633	. .	87 358
6813.90	Asbestos friction material and articles, n.e.s.						
	Germany	–	–	. .	55	. .	66
	United States	. .	26	. .	22	. .	21
	Other countries	. .	45	. .	9	. .	9
	Total	. .	71	. .	86	. .	96
Total exports, asbestos manufactured products		. .	261 058	. .	246 873	. .	247 213
IMPORTS							
2524.00.00.10	Crude asbestos	102	80	99	80	12	9
2524.00.00.90	Other asbestos	24	12	12	2	3	1
6811.10	Corrugated sheets of asbestos-cement, of cellulose fibre-cement, or the like	113	148	60	48	91	116
6811.20	Sheets n.e.s., panels/tiles, etc., of asbestos-cement, cellulose-fibre cement, etc.	6 892	6 297	10 772	10 140	17 752	16 190
6811.30	Tubes, pipes, and tube or pipe fittings of asbestos-cement, cellulose fibre-cement, etc.	805	888	1 039	1 047	1 273	941
6811.90	Articles n.e.s., of asbestos-cement, cellulose fibre-cement or the like	208	727	199	803	265	794
6812.10	Fabricated asbestos fibres; mixtures with a basis of asbestos or with a basis of asbestos and magnesium carbonate	59	193	114	553	–	–
6812.20	Asbestos yarn and thread	4	24	1	6	–	–
6812.30	Asbestos cords and string, whether or not plaited	25	115	17	138	–	–
6812.40	Asbestos woven or knitted fabric	37	281	24	207	–	–
6812.50	Asbestos clothing, clothing accessories, footwear and headgear	7	172	9	198	9	210
6812.60	Asbestos paper, millboard and felt	. .	360	. .	89	. .	79
6812.70	Compressed asbestos fibre jointing, in sheets or rolls	75	1 420	60	949	58	1 111
6812.90.00.10	Asbestos belting	505	2 028	359	1 955	334	1 567
6812.90.00.90	Other asbestos fabricated products n.e.s.	. .	584	. .	439	. .	762
6813.10	Asbestos brake linings and pads	. .	84 534	. .	71 529	. .	76 859
6813.90	Asbestos friction material and articles n.e.s.	. .	5 293	. .	5 876	. .	7 256
Total imports		. .	103 156	. .	94 059	. .	105 895

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary.
(1) EC includes Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADIAN CHRYSOTILE PRODUCERS, 2002

Producers	Mine Location	Normal Mill Capacity Ore/Day	Normal Mill Capacity Fibre/Year	Remarks
		(tonnes)		
LAB Chrysotile, Inc. (1)				Partnership owned 55% by LAQ and 45% by Mazarin Mining Corporation Inc.
Lac d'Amiante du Québec, Ltée (LAQ)	Black Lake, Que.	9 000	185 000	Open-pit. Since September 1989, LAQ has been owned by Jean Dupéré (President of LAB Chrysotile) and Connell Bros. Company, Ltd. of the United States.
Bell Asbestos Mines, Ltd.	Thetford Mines, Que.	2 700	100 000	Sold to Mazarin Mining Exploration Inc. on September 2, 1992. Underground Mine re-opened January 1989.
Jeffrey Mine Inc. Jeffrey mine	Asbestos, Que.	15 000	250 000	Open-pit (effective capacity reduced by one half since 1982).
Total of three producers at year-end			535 000	

Sources: National Resources Canada; The Asbestos Institute; United States Geological Survey; South Africa Department of Minerals and Energy.
(1) A partnership involving two operating companies.

TABLE 3. CANADA, ASBESTOS PRODUCTION AND EXPORTS, 1987-2002

	Crude Asbestos	Milled Fibres	Short Fibres	Total
		(tonnes)		
PRODUCTION (1)				
1987	–	365 144	299 402	664 546
1988	14	399 550	310 793	710 357
1989	–	410 588	303 448	714 036
1990	–	379 047	306 580	685 627
1991	–	335 506	350 502	686 008
1992	–	259 819	327 175	586 994
1993	–	235 908	287 059	522 967
1994	–	249 862	280 995	530 857
1995	–	255 621	259 932	515 553
1996	. .	241 188	265 088	506 276
1997	. .	. .	. .	420 278
1998	. .	. .	. .	321 330
1999	. .	. .	. .	337 367
2000	. .	. .	. .	309 719
2001	. .	. .	. .	276 790
2002 (p)	. .	. .	. .	240 500
EXPORTS				
1987	1 696	353 321	293 808	648 825
1988	11 288	381 561	292 236	685 085
1989	17 198	379 601	312 915	709 714
1990	1 469	378 074	269 942	649 485
1991	2 302	353 391	330 360	686 053
1992	1 489	272 013	327 075	600 577
1993	1 739	229 000	279 695	510 434
1994	2 155	248 804	280 394	531 353
1995	968	251 251	257 356	509 575
1996	911	239 111	263 985	504 007
1997	2 793	196 967	230 482	430 242
1998	3 485	157 621	158 324	319 430
1999	2 503	145 471	184 432	332 406
2000	3 557	133 529	178 240	315 326
2001	2 296	119 362	150 656	272 316
2002 (p)	1 947	143 517	89 674	235 138

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; (p) Preliminary.
(1) Producers' shipments.

Coal

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Coal is an organically derived material. It is formed from the remains of decayed plant material compacted into a solid through millions of years of chemical changes under pressure and heat. As the organic maturity process continues, the buried plant material is transformed into different kinds of coal. In general, the longer coal is subjected to heat and pressure, the higher its grade and contained heat volume per unit weight. Lignite and subbituminous are low-rank coals, also known as brown coals, consumed only for the generation of electricity. Bituminous coal and anthracite are high-rank coals, also known as hard coal. Bituminous coal is consumed for both metallurgical and thermal purposes. Anthracite, the highest rank coal, is often called smokeless and is consumed for both domestic and industrial purposes.

Coal is the world's most abundant and widely distributed fossil fuel. The current proven world coal reserve is estimated at 984 211 Mt spread over 100 countries. Coal is currently mined in more than 50 countries. Canada holds 8623 Mt, less than 1% of the world's reserves. Coal offers a long-term economical source of energy that, at current production levels, would last for more than 200 years, significantly longer than reserves of oil and gas.

Coal has been consumed as an energy source for hundreds of years. It provided the energy that boosted the industrial revolution of the 19th century and launched the electric era in the 20th century. Coal was the most important source of the world's primary energy until the late 1960s when it was overtaken by oil. Today, about 70% of total world coal production is consumed for electricity generation, providing about 37% of total world electricity production. About 16% of Canada's electricity is generated by coal. Almost all primary steel production worldwide is based on pig iron from blast furnaces fed with coke from coal, and iron ore.

CANADIAN DEVELOPMENTS

The Canadian coal industry plays an important role in the Canadian economy, both as a mining industry and as an energy provider. In 2002, about 67 Mt of coal was produced from 19 major coal mines and the coal industry directly employed approximately 6000 people. Close to one half of Canada's coal production was exported, primarily as metallurgical coal.

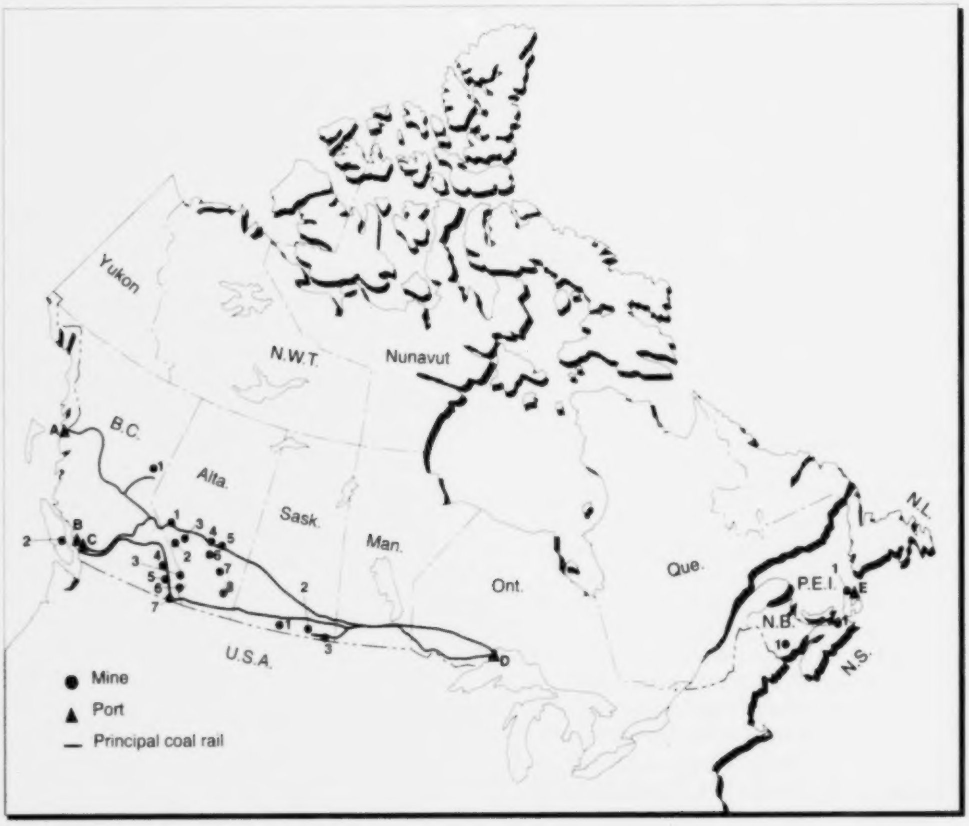
The consolidation of the Canadian coal industry has progressed over the last decade and may have approached its finale in early 2003. The Fording Canadian Coal Trust (Fording Trust) was formed at the end of February 2003 by Fording Inc., Teck Cominco Limited, Westshore Terminals Income Fund, Sherritt International Corporation, and the Ontario Teacher's Pension Plan. This new trust combined Fording, Luscar Energy Partnership and Teck Cominco Limited's metallurgical coal assets and created a subsidiary, the Elk Valley Coal Partnership. Fording's domestic thermal coal assets were transferred to the Luscar Energy Partnership, a 50:50 partnership between Sherritt and the Ontario Teacher's Pension Plan.

The Elk Valley Coal Partnership becomes the world's second largest exporter of metallurgical coal. It includes five mines in the Elk Valley of British Columbia and one mine in Alberta: Fording River, Coal Mountain, Greenhills, Elkview, Line Creek, and Luscar, with a total production capacity of approximately 25 Mt/y of metallurgical coal.

Luscar Coal Ltd., owned by the Luscar Energy Partnership, operates seven surface mines in Alberta: Coal Valley, Obed Mountain, Highvale, Paintearth, Sheerness, Whitewood and Genesee; and three in Saskatchewan: Poplar River, Boundary Dam and Bienfait. Combined these mines have a capacity of 40 Mt/y of bituminous, subbituminous and lignite thermal coal used mainly for domestic electric power generation.

There are several other smaller-scale producers in the Canadian coal industry. The Quinsam Coal Corporation in British Columbia, owned by Hillsborough Resources Limited, is the only underground mine currently in operation. It produced 340 000 t of coal in 2002. N.B. Coal Limited, a subsidiary of New Brunswick Power

Figure 1
Principal Canadian Coal Mines and Ports


Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
N.L.
P.E.I.
N.B.
N.S.
U.S.A.
A
B
C
D
E
1
2
3
4
5
6
7
8
● Mine
▲ Port
— Principal coal rail

Numbers refer to locations on map above.

MINES

BRITISH COLUMBIA

1. Bullmoose
2. Quinsam
3. Fording River
4. Greenhills
5. Elkview
6. Line Creek
7. Coal Mountain

ALBERTA

1. Obed Mountain
2. Luscar
3. Coal Valley
4. Highvale
5. Whitewood
6. Genesee
7. Paintearth
8. Sheerness

SASKATCHEWAN

1. Poplar River
2. Boundary Dam
3. Bienfait

NEW BRUNSWICK

1. Minto

NOVA SCOTIA

1. Stellarton

PORTS

BRITISH COLUMBIA

A. Ridley Terminals
B. Neptune
C. Westshore Terminals

ONTARIO

D. Thunder Bay

NOVA SCOTIA

E. International Pier

Corporation, produced 194 000 t in 2002 solely for power generation. With the closure of the Cape Breton Development Corporation's operations in 2001, coal production in Nova Scotia amounted to 189 000 t in 2002, coming from several smaller producers.

MINE OPENINGS AND CLOSURES

There are several new coal projects under development. The Pine Valley coal mine, a joint venture between Pine Valley Coal Ltd., owned by the Pine Valley Mining Corporation (66.7%) and Mitsui Matsushima Canada Ltd. (33.3%), is set to become the first new coal mine opened in British Columbia in 20 years. The mine is located approximately 45 km west of the town of Chetwynd in northeastern B.C. It is projected to produce 950 000 t/y with a mine life of 14 years. The coal will be exported for use as coking coal and pulverized coal injection (PCI). The mine produced a trial shipment of 84 400 t in 2002.

In early 2003, the Grande Cache Coal Company Inc. (GCC) received regulatory approval from the Alberta government to develop an underground mine and a surface mine, and for the operation of coal-processing facilities. The project is located near the town of Grande Cache where Smoky River Coal Limited had operated for over 30 years. The coal reserve is estimated at about 50 Mt and is expected to be mined over 25 years. Construction is scheduled to begin in mid- or late 2003. Upon completion, the mine will produce 2 Mt/y of metallurgical coal with a work force of 200. The coal will be exported to overseas steel producers.

The Wolverine coal project, under the ownership of the Western Canadian Coal Corp., is waiting for its Environmental Assessment approval. The project is located in Tumbler Ridge, an historical coal-producing region. The project includes an open-pit mine with a capacity of 1 Mt/y of metallurgical coal. Once the surface mine reaches full production, an underground mine will be constructed, adding another 1 Mt/y of capacity with a 12- to 15-year mine life. The project has the advantage of using an existing infrastructure, which includes a deep-sea shipping terminal, a railway network, power supply, and a full-service community.

The Cheviot coal mine project, which received federal government regulatory approval in April 2001, has been postponed by the Fording Trust, which believes that the existing production capacity of its subsidiary, the Elk Valley Coal Partnership, will meet market demands. The Fording Trust indicates that Cheviot is still a potential expansion project if market conditions change. If developed, the mine would be capable of producing about 3.5 Mt/y with approximately 500 employees.

The Brooks Power project, launched by Fording Inc. in December 2000, is uncertain due to environmental concerns and a lack of partners. The project, located in Brooks near Calgary, Alberta, would include a surface coal mine plus a two-unit 1000-MW coal-fired power generation plant. The mine would provide 44 Mt of coal for power generation over a 35-year mine life.

The Bullmoose mine, located in Tumbler Ridge in northeastern British Columbia, owned by Teck Cominco, is scheduled to close in 2003 due to the depletion of its coal reserves. The mine opened in 1983 and has provided more than 32 Mt of metallurgical coal to overseas steel producers.

The Luscar mine, located near Hinton, Alberta, will close by April 2004. The coal deposit is near depletion and its new owner, the Fording Trust, is currently phasing out the operations.

In April 2003, Luscar Ltd. suspended its Obed Mountain mine's operation indefinitely. Luscar cited the low world thermal coal price as the reason. The mine, located near Hinton, Alberta, began operations in 1984 and produced thermal coal for both domestic and international customers. It produced 1.1 Mt of thermal coal in 2002.

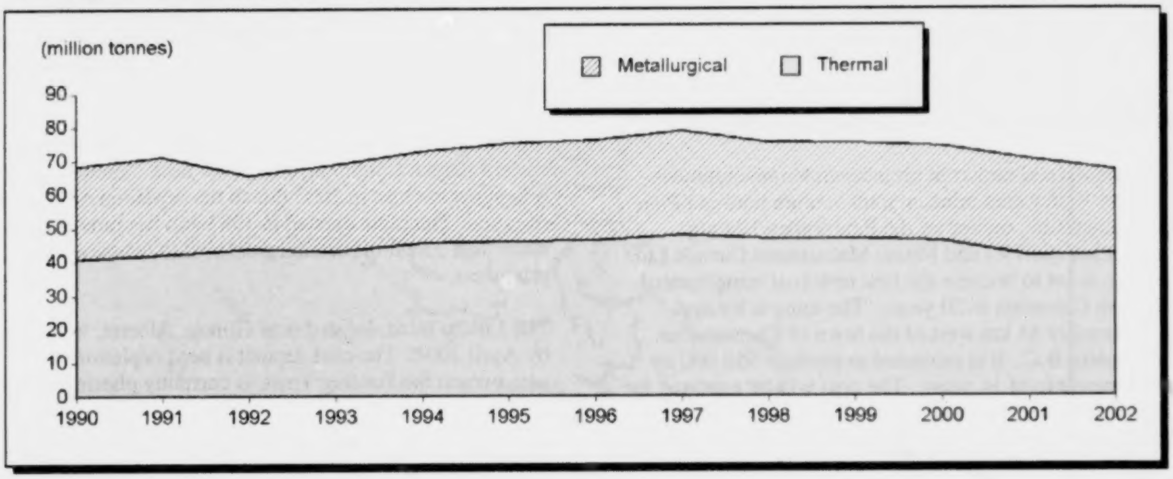
In trying to improve its competitiveness, the Fording Trust's Elk Valley Coal Partnership is reducing the Line Creek's annual production to 2 Mt from the previously planned 3.5 Mt and laying off 50% of its work force.

PRODUCTION

As world market conditions did not improve during 2002, Canadian coal production again suffered a downturn. Canada's production slid 5% to 67 Mt. The 3-Mt decline in metallurgical coal production occurred in British Columbia. Production in the rest of Canada, where most of the coal is consumed by coal-fired power generation plants, remained almost the same.

Three western provinces accounted for 97% of Canadian production. Alberta was Canada's largest coal-producing province with an output of 30 Mt in 2002, of which 90% was thermal and 10% was metallurgical. British Columbia was the second largest coal-producing province at about 24 Mt in 2002, of which 95% was metallurgical coal and the remaining 5% was thermal. Eighty percent of B.C.'s production was exported. Saskatchewan ranked third, producing about 11 Mt of lignite coal in 2002, all for thermal power generation. In Atlantic Canada, New Brunswick produced 194 000 t of thermal coal in 2002, exclusively consumed by New Brunswick Power Corporation to generate electricity. In Nova Scotia, a number of small mines combined to produce 189 000 t of thermal coal in 2002.

Figure 2
Canadian Coal Production, 1990-2002



Sources: Natural Resources Canada; Statistics Canada.

CONSUMPTION

Canadian coal consumption in 2002 was estimated similar to the previous year's at about 60 Mt. Ninety percent of the coal was used to generate electricity by 23 coal-fired generation plants across Canada. The Canadian steel industry consumed about 7% of the total and the remaining 3% was consumed by other industrial and domestic users. Alberta, the largest coal-consuming province, uses about 25 Mt annually for electric power generation, accounting for 40% of total Canadian consumption. Ontario is the second largest coal-consuming province using about 21 Mt in 2002: 17 Mt for power generation and 4 Mt by the steel industry. With no coal mines in the province, Ontario relies largely on U.S. imports, which amounted to about 19 Mt in 2002 with the remainder coming from Alberta and Saskatchewan. Saskatchewan's coal consumption was quite steady at about 9 Mt, all for electricity generation. Nova Scotia used about 1.9 Mt and New Brunswick used about 1.3 Mt, all for power generation. Some other provinces and territories consume a small amount of coal.

TRADE

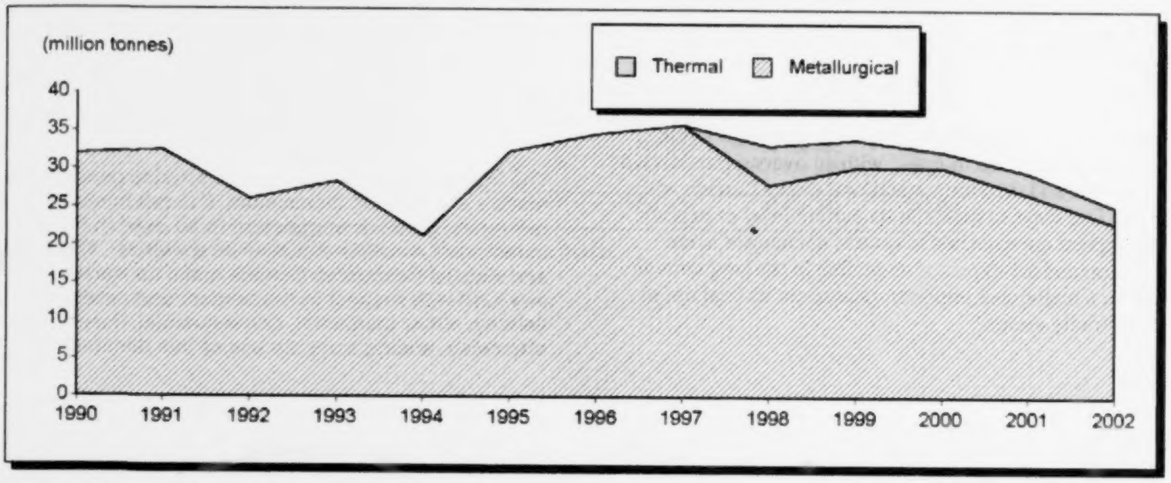
Coal exports are vital to the Canadian coal industry, with about half of Canada's production exported to the world steel industry. However, Canada's coal exports have been declining continuously since 1998 from 34 Mt to 25 Mt in 2002, sliding from the fifth largest exporter to the eighth largest. This was a result of weaker demand for metallurgical coal in the Japanese market, an oversupply on the world market, and increased exports from China and Australia.

Canadian exports are mainly from British Columbia where most of the coal mines produce metallurgical or coking coal. In 2002, British Columbia contributed 19.5 Mt of total exports while Alberta made up the remaining 5.2 Mt.

In early 2002, following an economic recovery in Asia, coking coal prices turned upward in Japan and South Korea. Canadian coking coal producers settled their contract price at US$48/t f.o.b., a 10% increase, with Japanese steel mills and Korean steel-makers. However, the world's coking coal markets did not improve much during 2002. In early 2003, Canadian coal producers settled contract prices with Japanese steel mills at US$46/t f.o.b., US$2 lower than the 2002 price.

Canada's coal imports have shown an increasing trend due to demand from coal-fired electric power-generating plants. In 2002, Canada imported about 22.7 Mt of coal. Ontario was the major coal importer, followed by Nova Scotia (1.7 Mt) and New Brunswick (1.1 Mt). Quebec imported about 800 000 t of coal for industrial uses. Saskatchewan, Alberta, British Columbia and Manitoba also imported small amounts of coal. Thermal coal, a traditional import, accounted for 80% of total imports (about 18.4 Mt) and the remaining imports (4.3 Mt) were metallurgical coal. Coal imports came mainly from the United States, about 88%; Colombia, 9%; and other countries, 3%.

Figure 3
Canadian Coal Exports, 1990-2002



Sources: Natural Resources Canada; Statistics Canada.

TRANSPORTATION

Coal is the number one commodity carried by rail in Canada. In 2000, both Canadian Pacific Limited and the Canadian National Railway Company transported a total of 34 Mt of coal. The majority of export coal is transported to west coast ports for shipping worldwide. The major coal-loading terminal, Westshore Terminals, located in Roberts Bank, Vancouver, loaded 19.4 Mt of coal in 2002. Neptune Terminals in Vancouver, Ridley Terminals in Prince Rupert, and the Port of Thunder Bay are other coal-loading ports. The International Pier in Sydney, Nova Scotia, previously loaded coal for export but now only receives coal imports.

ENVIRONMENT

Canada formally ratified the Kyoto Protocol in 2002, demonstrating the Canadian government's commitment to limit greenhouse gas (GHG) emissions to protect the environment. Natural Resources Canada (NRCan) established a Large Industrial Emitters Group to work with industries to reduce GHG emissions.

Environmental concerns with respect to the coal industry include the disturbance of lands, acid drainage, GHG emissions and the production of particulate associated with the burning of coal.

New coal mines and expansions are required to have environmental assessments under provincial legislation and, in some cases, also need a federal environmental review under the *Canadian Environmental Assessment Act*. Environmental assessments ensure that mining activities, such as the removal of vegetation, relocation of overburden, construction of roads, reclamation of previous mined areas, and mining operations, have minimal negative effect on the environment. Several Canadian mining companies have already been recognized for their successful environmental management programs.

Canada and the private sector have invested significant amounts of money into the development of Clean Coal Technologies (CCT) designed to enhance both the efficiency and the environmental acceptability of coal extraction, preparation and consumption.

NRCan has recently invested $1.66 million in a project led by the Canadian Clean Power Coalition (CCPC) to retrofit an existing coal-burning power plant to reduce GHG emissions by 50%. The CCPC also hopes to build a new plant capable of reducing emissions up to 90% that will serve as a prototype for future plant construction. In the southwest of Edmonton, Alberta, TransAlta Utilities Corporation and EPCOR are building a 450-MW coal-fired power plant, the Genesee 3 project, equipped with new technologies that will reduce GHG emissions up to 50%.

OUTLOOK

No significant change is expected in the coal situation in Canada. Coal production is expected to remain at about 70 Mt/y in the short term.

Coal consumption is also expected to remain unchanged in the short term. In the long term, coal-fired electricity generation use is expected to decline as Ontario is planning to phase out coal used for electricity generation. However, in British Columbia's 2002 energy plan, the province encourages investment in energy development, including coal and coal-fired electricity generation.

Coal exports are expected to stay flat. Although world coal trade is expected to grow, with an oversupplied world coal market and declining world coal prices Canada will have to find ways to maintain its current level of exports. Coal imports are expected to remain unchanged in the short term and are expected to decline in the long term as Ontario, a major coal importer, phases out its coal use in the electricity sector.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of July 1, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

		Canada			United States	EU	Japan	Brazil	India	Taiwan	Korea
Item No.	Description	MFN	GPT	USA	Canada	MFN	WTO (1)	MFN	MFN	MFN	MFN
27.01	Coal, briquettes, ovoids and similar solid fuels manufactured from coal. Coal whether or not pulverized, but not agglomerated.										
2701.11.00	Anthracite	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.11.00.10	Buckwheat No. 4, 5 or 6	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.11.00.20	Buckwheat No. 1, 2 or 3	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.11.00.30	Egg, stove or nut size	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.11.00.90	Other	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.12.00	Bituminous coal, metallurgical coal	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.12.00.11	High volatile	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.12.00.12	Low volatile	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.12.00.91	Other high volatile	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.12.00.92	Other low volatile	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.19.00	Other coal	Free	Free	Free	Free	Free	Free	Free	25%	Free	1%
2701.20.00	Briquettes, ovoids and similar solid fuels manufactured from coal	Free	Free	Free	Free	Free	3.9%	Free	15%	Free	1%
27.02	Lignite, whether or not agglomerated, excluding jet	Free	Free	Free	Free	Free	Free	Free	15%	Free	1%
2702.10.00	Lignite, whether or not pulverized, but not agglomerated	Free	Free	Free	Free	Free	Free	Free	15%	Free	1%
2702.20.00	Agglomerated lignite	Free	Free	Free	Free	Free	Free	Free	15%	Free	1%
2704.00.00	Coke and semi-coke of coal, of lignite or of peat, whether or not agglomerated; retort carbon; coke and semi-coke of coal	Free	Free	Free	Free	Free	Free-3.2%	Free	15%	Free - 1%	5%
2704.00.11	Comercially suitable for use as fuel	Free	Free	Free	Free	Free	Free-3.2%	Free	15%	Free-1%	5%
2704.00.19	Coke and semi-coke of coal; other	Free	Free	Free	Free	Free	Free-3.2%	Free	15%	Free-1%	5%
2704.00.90	Coke and semi-coke of coal, of lignite or of peat, retort carbon; other	Free	Free	Free	Free	Free	Free-3.2%	Free	15%	Free-1%	5%

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Brazil* (9th Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of India* (9th Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Korea* (9th Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Taiwan* (7th Annual Edition: 2002); *Customs Tariff Schedules of Japan*, 2003.

(1) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. COAL PRODUCTION, 2001 AND 2002

	2001		2002 (p)	
	(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS				
Nova Scotia	x	x	x	x
New Brunswick	165 000	19 923	194 000	22 088
Saskatchewan	x	x	x	x
Alberta	30 911 000	389 377	30 758 000	386 698
British Columbia	27 007 000	959 292	24 373 000	1 024 311
Total	70 354 500	1 557 115	66 822 000	1 593 091

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary; x Confidential.

TABLE 2. CANADIAN COAL TRADE, 2001 AND 2002

		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
2701.11	Anthracite				
	United States	13	5 397	–	–
2701.12	Bituminous coal, metallurgical				
	Japan	9 760 529	603 413 087	8 925 934	573 850 357
	South Korea	3 773 307	227 966 028	3 203 568	208 956 686
	United States	2 088 111	181 912 458	1 592 612	150 666 389
	Turkey	781 777	52 495 616	1 014 403	86 154 114
	Brazil	1 578 242	92 670 208	1 172 716	80 401 083
	Netherlands	1 567 537	113 049 727	1 036 453	79 642 816
	United Kingdom	1 167 900	71 761 150	1 113 706	76 167 671
	Germany	1 151 882	75 880 115	1 046 394	74 743 677
	Taiwan	1 046 865	61 906 539	1 077 313	67 081 637
	Italy	1 257 643	75 025 677	705 458	46 747 609
	France	411 573	25 962 878	259 266	20 319 150
	Egypt	321 090	18 345 381	266 224	19 556 222
	Spain	114 923	7 600 795	331 850	19 187 579
	Mexico	436 648	26 392 717	257 398	16 764 284
	Pakistan	153 678	7 346 844	257 166	15 936 867
	Belgium	237 211	14 104 432	227 569	15 810 824
	Chile	633 669	31 143 857	259 076	14 337 080
	Finland	301 768	20 052 863	146 909	10 900 985
	South Africa	–	–	69 684	5 354 868
	Jordan	62 185	3 884 932	–	–
	Bulgaria	67 930	4 687 422	–	–
	Total	26 914 468	1 715 602 746	22 963 699	1 582 579 898
2701.12	Bituminous coal, other				
	South Korea	2 011 545	77 888 418	1 271 395	48 810 566
	Japan	525 783	23 211 485	462 148	24 733 803
	United States	166 080	7 680 344	202 416	11 263 612
	Chile	–	–	142 147	5 970 149
	United Kingdom	–	–	23 978	1 659 653
	Total	2 703 408	108 780 247	2 102 084	92 437 783
2701.19	Other coal				
	Taiwan	–	–	380	181 707
	United States	140	61 982	369	169 985
	China	–	–	60	30 246
	Italy	20	10 814	–	–
	Total	160	72 796	809	381 938
2702.10	Lignite whether or not pulverized, but not agglomerated				
	United States	68 339	7 770 037	78 307	9 095 156
2702.20	Agglomerated lignite				
	United States	10 063	2 156 635	40 625	6 720 294
	France	–	–	36	7 118
	Total	10 063	2 156 635	40 661	6 727 412
	Total exports	29 696 451	1 834 387 858	25 185 560	1 691 222 187

TABLE 2 (cont'd)

		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS					
2701.11	Anthracite				
	United States	309 566	37 349 718	244 347	29 929 798
	China	120 803	18 547 169	88 211	12 363 827
	Ukraine	19 819	2 069 785	48 821	4 383 402
	Russia	44 527	4 948 355	41 826	4 203 942
	Other countries	10	1 366	105	35 205
	Total	494 725	62 916 393	423 310	50 916 174
2701.12	Bituminous coal, metallurgical				
	United States	3 942 073	226 566 005	4 277 629	279 656 642
	Norway	19 356	1 117 998	–	–
	Poland	8 473	692 724	–	–
	Australia	–	–	. . .	25
	Colombia	16 970	1 098 196	23 967	3 321 395
	Total	3 986 872	229 474 923	4 301 596	282 978 062
2701.12	Bituminous coal, other				
	United States	10 783 930	511 552 712	8 408 993	481 058 272
	Colombia	415 624	31 192 173	1 013 734	62 524 933
	Venezuela	261 991	20 615 436	359 940	28 233 173
	Aruba	–	–	54 631	4 718 257
	United Kingdom	–	–	49 517	4 195 263
	China	–	–	195	14 894
	Total	11 461 545	563 360 321	9 887 010	580 744 792
2701.19	Other coal				
	United States	1 435 812	78 648 272	7 003 938	128 356 028
	Colombia	1 979 905	90 265 636	1 007 614	46 914 253
	Venezuela	65 771	3 298 161	54 144	2 614 085
	Other countries	73	2 233	1 308	63 406
	Total	3 481 561	172 214 302	8 067 004	177 947 772
2701.20	Briquettes, ovoids and similar solid fuels manufactured from coal				
	United States	2 957	316 468	234	28 793
	Other countries	113	8 376	5	349
	Total	3 070	324 844	239	29 142
2702.10	Lignite whether or not pulverized, but not agglomerated				
	United States	1 545	164 120	1 707	161 707
	Finland	1	1	1	140
	Total	1 546	164 121	1 708	161 847
2702.20	Agglomerated lignite				
	Netherlands	24	7 352	–	–
	United States	11	1 600	–	–
	Total	35	8 952	–	–
	Total imports	19 429 355	1 028 463 856	22 680 869	1 092 777 789

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary.

TABLE 3. CANADIAN COKE TRADE, 2001 AND 2002

		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
2704.00	Coke and semi-coke of coal, of lignite or of peat, whether or not agglomerated; retort carbon				
	United States	57 982	15 435 592	95 853	11 309 897
	United Arab Emirates	–	–	377	264 227
	Trinidad and Tobago	–	–	379	127 331
	Montserrat	–	–	120	25 105
	Costa Rica	–	–	404	23 467
	United Kingdom	–	–	1	6 503
	Total	57 982	15 435 592	97 134	11 756 530
IMPORTS					
2704.00	Coke and semi-coke of coal, of lignite or of peat, whether or not agglomerated; retort carbon				
	United States	1 122 223	121 058 619	769 470	72 277 123
	China	142 621	13 859 275	172 310	20 072 154
	Switzerland	22 934	1 780 561	99 150	4 938 683
	Brazil	1	1	43 833	4 170 520
	Germany	3 828	377 963	7 179	1 343 691
	Other countries	40	5 257	10	874
	Total	1 291 647	137 081 678	1 091 952	102 803 045

Sources: Natural Resources Canada; Statistics Canada.
– Nil; (p) Preliminary.

TABLE 4. COAL PRODUCTION BY TYPE AND PROVINCE, 1990-2002

		Alberta			British Columbia	New Brunswick	Nova Scotia	Saskatchewan	Canada
		Bituminous	Subbituminous	Total	Bituminous	Bituminous	Bituminous	Lignite	Total
		(000 tonnes)							
1990	Metallurgical	5 455	–	5 455	21 691	548	513	–	27 659
	Thermal	3 698	21 252	24 950	2 865	–	2 902	9 407	40 672
	Total	9 153	21 252	30 405	24 556	548	3 415	9 407	68 331
1991	Metallurgical	6 117	–	6 117	22 039	–	918	–	29 074
	Thermal	4 195	22 242	26 437	2 924	498	3 220	8 981	42 060
	Total	10 312	22 242	32 554	24 963	498	4 138	8 981	71 134
1992	Metallurgical	6 395	–	6 395	14 680	–	962	–	22 [illegible]7
	Thermal	4 113	23 020	27 133	2 494	399	3 524	10 027	43 577
	Total	10 508	23 020	33 528	17 174	399	4 486	10 027	65 614
1993	Metallurgical	6 483	–	6 483	18 770	–	535	–	25 789
	Thermal	5 015	23 660	28 675	1 858	389	3 111	9 000	43 034
	Total	11 498	23 660	35 159	20 628	389	3 647	9 000	68 824
1994	Metallurgical	5 795	–	5 795	20 887	–	582	–	27 265
	Thermal	4 399	25 489	29 888	1 717	331	2 927	10 684	45 550
	Total	10 195	25 489	35 684	22 604	331	3 509	10 684	72 815
1995	Metallurgical	6 783	–	6 783	22 203	–	67	–	29 054
	Thermal	4 739	25 621	30 361	2 146	263	2 414	10 739	45 925
	Total	11 523	25 621	37 144	23 349	263	2 482	10 739	74 979
1996	Metallurgical	6 671	–	6 671	22 890	–	134	–	29 696
	Thermal	4 492	24 985	39 478	2 529	272	3 037	10 838	46 157
	Total	11 164	24 985	36 150	25 420	272	3 171	10 838	75 853
1997	Metallurgical	5 831	–	5 831	25 017	–	70	–	30 919
	Thermal	4 728	25 782	30 511	2 860	173	2 645	11 652	47 843
	Total	10 560	25 782	36 343	27 878	173	2 715	11 652	78 762
1998	Metallurgical	5 422	–	5 422	23 170	–	–	–	28 592
	Thermal	5 449	25 285	30 734	1 695	272	2 118	11 790	46 611
	Total	10 871	25 285	36 156	24 866	272	2 118	11 790	75 204
1999	Metallurgical	5 299	–	5 299	23 126	–	–	–	28 426
	Thermal	4 604	24 299	28 903	1 717	251	1 537	11 659	46 611
	Total	9 903	24 229	34 203	24 844	251	1 537	11 659	75 204
2000	Metallurgical	3 871	–	3 871	24 230	–	–	–	28 101
	Thermal	2 857	24 168	27 025	1 450	229	1 165	11 190	46 061
	Total	6 728	24 168	30 896	25 681	229	1 165	11 190	69 163
2001	Metallurgical	2 950	–	2 950	25 774	–	–	–	28 724
	Thermal	3 021	24 940	27 961	1 233	165	881	11 390	41 630
	Total	5 971	24 940	30 911	27 007	165	881	11 390	70 354
2002 (p)	Metallurgical	. .	–	. .	. .	–	–	–	x
	Thermal	. .	. .	. .	. .	194	x	x	x
	Total	. .	. .	30 485	24 397	194	x	x	66 822

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; (p) Preliminary; x Confidential.

TABLE 5. CANADIAN COAL USE, 1990-2002

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 (r)	2001 (r)	2002 (p)
							(000 tonnes)						
ELECTRICITY GENERATION													
Domestic													
Bituminous	5 821	5 500	5 880	5 357	5 448	4 976	4 888	4 323	3 362	3 516	1 911	2 076	. .
Subbituminous	20 862	22 071	23 156	23 652	27 154	25 796	25 413	25 856	25 343	24 313	24 149	24 919	. .
Lignite	9 088	8 849	9 576	9 711	9 415	10 517	10 959	11 290	11 686	11 374	10 857	11 130	. .
Subtotal Canadian	35 771	36 420	38 612	38 720	42 017	41 289	41 260	41 469	40 391	39 203	36 918	38 125	. .
Imported													
Bituminous	6 371	7 426	6 841	4 282	3 906	5 215	5 646	8 036	10 136	10 245	12 363	11 071	. .
Subbituminous	. .	. .	. .	. .	. .	. .	. .	. .	2 397	2 269	5 004	4 947	. .
Subtotal imported	6 371	7 426	6 841	4 282	3 906	5 215	5 646	8 036	12 533	12 514	17 367	16 018	. .
Total generation use	42 142	43 846	45 453	43 002	45 923	46 504	46 906	49 505	52 924	51 717	54 285	54 143	. .
OTHER INDUSTRY													
Domestic													
Bituminous	277	285	340	367	289	426	256	247	267	287	375	405	. .
Lignite	275	227	231	301	252	342	514	331	272	221	312	291	. .
Subtotal Canadian	552	512	571	668	541	768	770	578	539	508	687	696	. .
Imported													
Anthracite	342	219	274	231	281	396	462	435	514	458	526	339	. .
Bituminous	1 008	827	688	689	824	916	929	694	1 010	1 034	1 132	987	. .
Subtotal imported	1 350	1 046	962	920	1 105	1 312	1 391	1 129	1 524	1 492	1 658	1 326	. .
Total other industry use	1 902	1 558	1 533	1 588	1 646	2 080	2 161	1 707	2 063	2 000	2 345	2 022	. .
METALLURGICAL													
Domestic	. .	. .	. .	. .	227	288	101	. .	27	177	217	204	. .
Imported	4 996	4 906	4 886	4 665	4 552	3 901	4 345	4 490	4 092	4 183	4 048	4 052	4 302
Total metallurgical	4 996	4 906	4 886	4 665	4 779	4 189	4 446	4 490	4 119	4 360	4 265	4 256	. .
TOTAL COAL USE													
Domestic	36 323	36 932	39 183	39 388	42 785	42 346	42 132	42 047	40 957	39 888	37 822	39 025	. .
Imported	14 840	11 835	13 750	8 723	9 055	9 749	11 647	14 818	19 854	19 960	19 641	19 452	22 681
Total	51 163	48 767	52 933	48 111	51 840	52 095	53 779	56 865	60 811	59 848	57 463	58 477	. .

Sources: Natural Resources Canada, Statistics Canada.
. . Not Available; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 6. COAL USE FOR ELECTRICITY GENERATION, BY PROVINCE, 1990-2002

	Alberta	New Brunswick	Nova Scotia	Manitoba	Ontario	Saskatchewan	Canada
				(000 tonnes)			
1990	21 340	496	2 184	298	10 362	7 462	42 142
1991	22 480	426	2 290	232	10 850	7 548	43 826
1992	23 752	471	2 344	233	10 022	8 419	45 241
1993	24 194	506	2 416	178	7 004	8 428	42 726
1994	28 207	1 208	2 672	164	5 170	8 502	45 923
1995	26 201	1 304	2 578	117	6 707	9 597	46 503
1996	25 794	1 370	2 864	176	6 984	9 719	46 906
1997	26 258	1 327	2 986	106	9 012	9 820	49 508
1998	25 963	1 433	2 597	546	12 342	9 795	52 677
1999	25 171	1 379	2 868	303	12 151	9 844	51 717
2000	24 768	1 242	3 322	561	15 209	9 180	54 284
2001	25 430	1 404	3 350	273	14 250	9 436	54 143
2002	. .	. .	. .	. .	. .	. .	. .

Sources: Natural Resources Canada; Statistics Canada.
. . Not available.
Note: Numbers may not add to totals due to rounding.

TABLE 7. CANADIAN COAL TRADE, 1990-2002

	Metallurgical		Thermal		Canada	
	(000 t)	($ 000)	(000 t)	($ 000)	(000 t)	($ 000)
EXPORTS						
1990	31 986	2 109 070	. . .	. . .	32 058	2 118 544
1991	32 402	2 043 515	. . .	. . .	32 483	2 051 543
1992	25 910	1 666 905	. . .	. . .	26 134	1 684 015
1993	28 249	1 845 140	. . .	. . .	28 352	1 855 193
1994	31 243	2 039 875	. . .	. . .	31 311	2 047 200
1995	34 054	2 228 708	. . .	. . .	34 215	2 238 002
1996	34 594	2 495 138	. . .	. . .	34 697	2 503 686
1997	35 614	2 572 747	. . .	. . .	35 886	2 594 762
1998	27 972	2 060 927	5 215	301 593	33 186	2 362 520
1999	30 289	1 746 020	3 672	154 126	33 960	1 900 146
2000	30 305	1 632 441	2 196	89 358	32 501	1 721 799
2001	26 914	1 715 603	2 782	118 792	29 696	1 834 395
2002 (p)	22 964	1 582 580	2 319	108 642	25 283	1 691 222
IMPORTS						
1990	4 021	185 421	10 819	426 879	14 840	612 300
1991	4 171	189 627	7 665	288 520	11 835	478 147
1992	4 733	216 429	9 017	375 259	13 750	591 688
1993	4 721	227 404	4 002	183 819	8 723	411 223
1994	4 048	201 583	5 007	232 349	9 055	433 932
1995	4 183	211 235	5 566	264 198	9 749	475 434
1996	5 465	283 250	6 183	288 448	11 647	571 697
1997	4 616	238 944	10 202	453 898	14 818	692 843
1998	4 536	258 201	15 318	671 063	19 854	929 264
1999	3 857	204 018	16 103	717 592	19 960	921 609
2000	3 493	183 214	16 148	763 377	19 641	946 591
2001	3 987	229 475	15 465	798 989	19 452	1 028 464
2002 (p)	4 302	282 978	18 379	809 800	22 681	1 092 778

Source: Natural Resources Canada.
. . . Amount too small to be expressed; (p) Preliminary.

Copper

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This chapter reviews events in the Canadian copper industry in 2002 and provides some outlook for the Canadian industry and prices. The electronic version of this chapter is available at www.nrcan.gc.ca/mms/cmy/content/2002/25.pdf.

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SUMMARY

RECENT WORLD COPPER DATA

	2001	2002 (p)
	(Mt)	
Mine production	13.659	13.566
Primary refined production	13.684	13.429
Secondary refined production	1.902	1.891
Total refined production	15.586	15.32
Usage (consumption)	14.807	15.069
Refined stocks at year-end	2.109	2.212

Source: International Copper Study Group, ICSG Copper Bulletin, May 2003.
(p) Preliminary.

2002 LME PRICES FOR GRADE A COPPER

	Cash	3 Month	15 Month	27 Month
		(US$/t)		
Average	1 557	1 576	1 634	1 669
Minimum	1 690	1 710	1 763	1 790
Maximum	1 421	1 445	1 515	1 560

Source: Calculated from London Metal Exchange (LME) daily data available at www.lme.co.uk/2628.html (note conditions of use).
Notes: Cash ask price = settlement price. Refer to Figure 11 for a graph of copper prices for the period 1989 to 2002. For a definition of Grade A copper, see LME web site at www.lme.co.uk/2314.asp. For copper brands listed on the LME, go to www.lme.co.uk/2319.asp. The average value of the Canadian dollar in 2002 was US$0.6369 (see www.bankofcanada.ca/en/exchange-look.htm for daily and other rates).

RECENT CANADIAN DATA

	2001	2002 (p)
	(tonnes)	
Copper mine production	633 500	600 200
Reported copper mine production (rounded to nearest 1000 t)	618 000	602 000
Copper refined production	567 700	494 300
Copper domestic shipments	257 200	257 100
Copper refined imports	8 000	11 600
Apparent copper usage	265 200	268 700

Source: Natural Resources Canada (except company reports), see http://mmsd1.mms.nrcan.gc.ca/mmsd/data/2002/02mtly12.pdf.
Notes: NRCan data are rounded to the nearest 100 t except for reported copper mine production, which is rounded to nearest 1000 t. Use = domestic shipments + refined imports. Reported copper mine production is taken from company reports and is a mixture of copper in concentrates produced and payable copper in concentrates, depending upon the company.

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VALUE ADDED

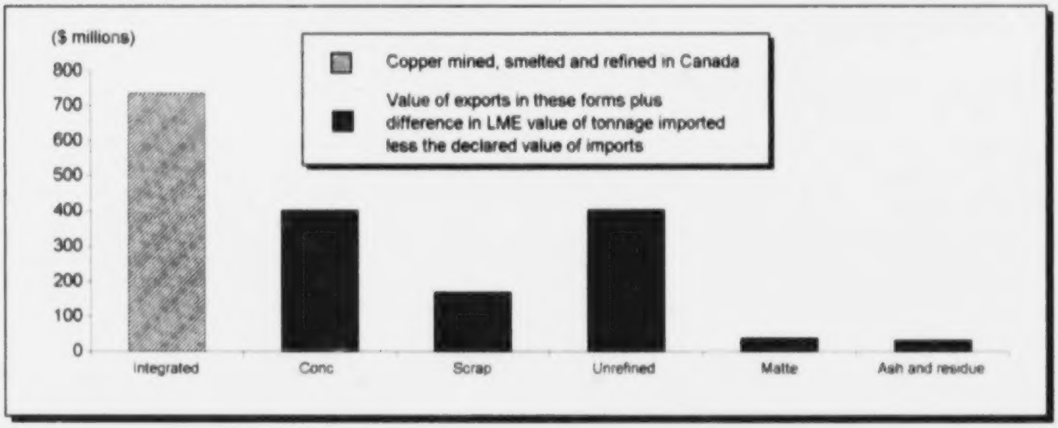
The "value added" of the Canadian copper industry up to refined metal was approximately $1800 million in 2002. This value reflects the value of the production and processing of materials originating in Canada, the value of intermediate exports, and the value added of raw materials imported for treatment in Canada. Such raw materials include:

- copper in concentrates (H.S. 2603);
- copper in ash and residues (H.S. 2629.30);
- copper in waste and scrap (H.S. 7404);
- unrefined copper (H.S. 7402) such as precipitates; and
- copper in mattes (H.S. 7401).

The data are not complete enough for an exact calculation. For example, some of the waste and scrap imported is brass and bronze, which has a higher value than copper, so using the tonnage of scrap imports valued at the London Metal Exchange (LME) settlement price for Grade A copper would undervalue the final value of the products made from the imports (i.e., brass scrap is imported to make brass, not to be put into a copper smelter to recover the copper values). Offsetting this is the inaccuracy in some tonnage data; only the gross weights of most imports are recorded and, as such, the contained metal may not be equal to the gross weight of the imports. For example, the copper contained in ash and residue may be much less than the gross tonnage and so a valuation of the potential products by multiplying the gross weight of the copper ash and residue imports by the copper value overvalues these imports. However, such ashes and residues may contain precious metals, which have a unit value many times that of copper. Thus, the value-added data are illustrative of actual value added.

One can see that the greatest contribution to value added occurs from the copper mined and processed in Canada; this material accounts for over 40% of copper's total value added. Concentrates traded account for about one quarter of the total value added – this includes the value of copper concentrates exported and the difference between the declared value of the concentrate imports and the value of the copper produced from these imports. Unrefined copper is similar to copper concentrates, accounting for about one quarter of copper's total value added of $1800 million.

Figure 1
Copper, Value Added (1) by Source, 2002



Sources: Statistics Canada; Bank of Canada exchange rate; London Metal Exchange price for Grade A copper.
(1) Approximate value

CANADIAN DEVELOPMENTS

The Canadian primary copper industry is in reality a number of distinct copper industries. Some mines[a] produce copper as a co-product[b] of another metal such as nickel, zinc or gold, and some mines produce copper as a by-product[c] of other metals. Some copper mines sell their output in the form of copper concentrate to custom smelters in Canada or overseas. Some of the smelters process feed from their own mines/mills. Others supplement their corporate feed with purchased concentrates; one (the Horne smelter) processes almost entirely material purchased from other companies. Smelters that purchase concentrate are known as custom smelters. Each of these groups reacts differently to changing market conditions. In the case of smelting and refining, for example, the mines selling copper concentrates get paid a price related to the world price for refined copper, usually the LME price,[d] less the "treatment charges and refining charges" (TCRCs).[e] TCRCs are the amounts charged by smelters and refineries that purchase copper concentrates and process these concentrates to refined copper. The treatment charge is the amount charged to smelt the concentrate; the refining charge is the amount charged to refine the anode or blister copper to a high-purity copper cathode, the form that most copper users want. TCRCs are set by market forces – when there is a surplus of copper concentrates compared to the smelting and refining capacity, then TCRCs rise. When there is a shortage of copper concentrates relative to smelting and refining capacity, as was the case in 2002 for example, then TCRCs fall. Smelters try to operate at high rates of utilization in order to keep their unit costs low, staying competitive relative to other smelters. But eventually, if TCRCs are low for an extended period of time, then some smelters close because they are uncompetitive. A case in point is the Gaspé smelter, which closed permanently in 2002.

If copper prices are low for an extended period, then some mines that are losing money will close. In addition, there will be less investment in new copper mine capacity because of the projected poor returns on investment. Together these factors reduce the supply of copper concentrates, which changes the supply-demand balance and leads to lower TCRCs as smelters compete for scarcer supplies of concentrate feed. When copper prices rise, mines may re-open or new ones may start up; as the amount of copper in concentrates increases, the TCRCs will increase.

The share of the LME price that is retained by smelters and refineries is variable; it varies from a low of about 20% of LME prices up to 35%. From a graph published by AME Mineral Economics in February 2002,[1] the smelter/refinery share of LME prices appears to have generally trended downward from 1975 to about 1988. After this period, the fluctuation became more erratic, but peaked at over 30% of LME in 1998 before dropping back to about 25% of LME prices as of early 2002.

In Canada, there are concentrate sellers that benefit from low TCRCs. There are also custom smelters, such as Noranda Inc., that benefit from high TCRCs. One might describe Inco Limited, a very large integrated copper producer, as presently being largely unconcerned about TCRCs as Inco does not sell or buy appreciable amounts of copper concentrates. However, this will change by 2006 when Voisey's Bay is expected to come into production; at that time, Inco plans to sell the majority of the copper produced by the project to custom smelters.

The production of copper in Canada is associated with the production of other metals (and sulphuric acid). There is no Canadian copper mine whose revenue from its domestic operations is derived entirely from copper. The role of other metals in Canadian copper production in terms of value and production was estimated for 2002 production and the result is presented in graphical form in Figure 2.

Canadian copper production and processing is a net earner of foreign exchange, earning a net of $965 million; total exports in 2002 were $2205 million and total imports were $1240 million. Figure 3 shows the imports and exports of three groups of copper products and the associated trade balances for each group. The three groupings of products are:

- concentrates, anode copper, and refined copper;
- semi-fabricated items, including alloys of copper and ingots; and
- fabricated items.

---

[a] The author's use of the term "mine" includes the concentrator or mill associated with the mine. At present, all copper mined in Canada is crushed and milled in a process in which much of the waste is removed from the mine ore. The output from the mill is termed a "concentrate" or higher-grade material. The concentrate is used as feed to copper smelters. A short description in English of the flotation process can be found at http://60centuries.copper.org/modern/modern02_a.html. The location of the description of the smelting and refining process is available in English at http://60centuries.copper.org/modern/modern03_a.html.

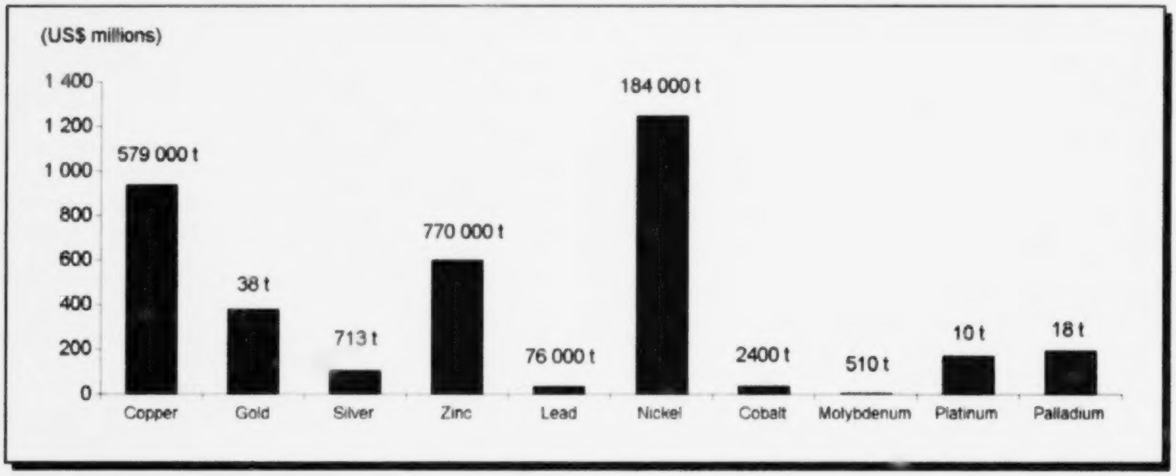
[b] When copper is a co-product, it is an important, but not the principal, source of revenue from the mine output.

[c] When copper is a by-product, it is a relatively insignificant source of revenue from the mine output and changes in the copper price are unlikely to result in major changes to the mine operating plans.

[d] LME prices are set daily in the United Kingdom.

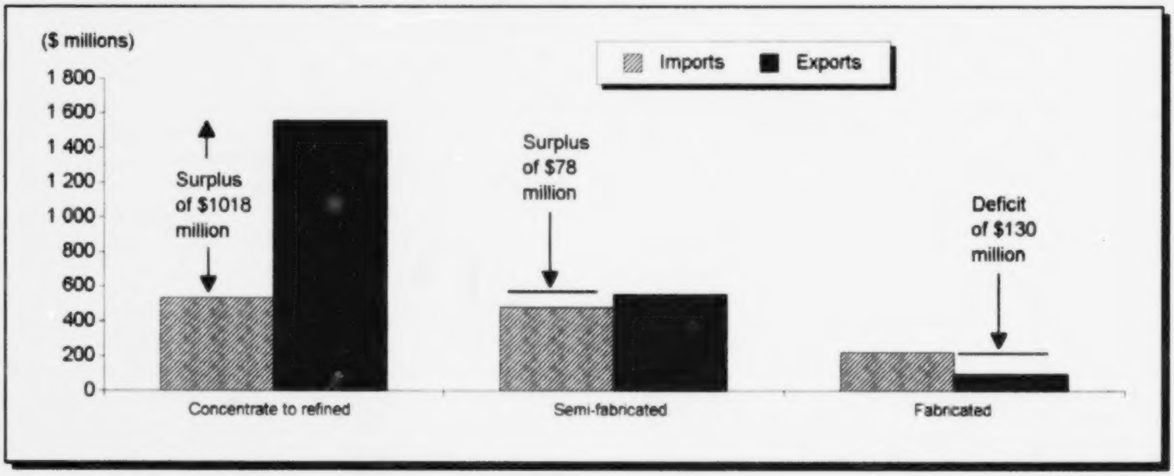
[e] Freight, insurance, payment for contained metals such as gold and silver, penalties for deleterious impurities, price escalation factors, etc., are also calculated but, for the sake of simplicity, these are ignored here.

Figure 2
Value (1) and Quantity (2) of Metals Recovered with Copper Mined in Canada, 2002



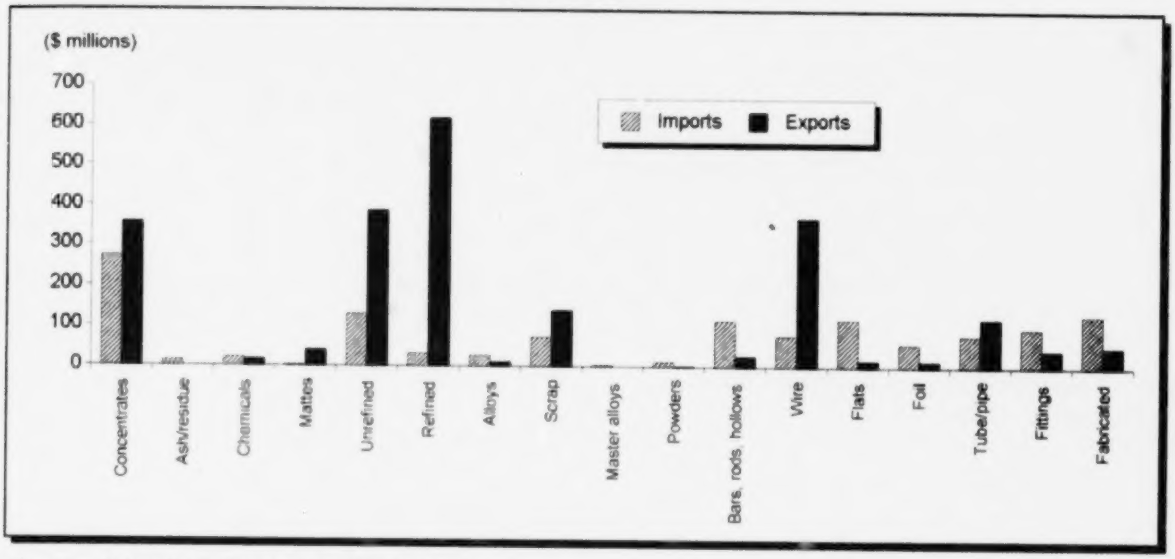
Sources: Company reports; author's criteria for grouping; average metal prices for 2002.
(1) Value is approximate as companies may report metal in concentrate, payable metal, or deliveries. (2) Approximate amount of metal in concentrate.

Figure 3
Canadian Copper Trade by Processing Stage, 2002



Sources: Natural Resources Canada; Statistics Canada.

Figure 4
Canadian Copper Trade, by Product Type, 2002



Sources: Natural Resources Canada; Statistics Canada.

These groupings can be broken down into more detail that shows the relative trade balances for the detailed trade classifications. These are presented in Figure 4.

More detailed trade data are shown in Table 1, which lists trade by Harmonized System (H.S.) code and by country of destination for products and origin for imports.

The most important net trade earnings (export revenues less import revenues) generated by copper and copper alloy products were in the following groupings:[f]

• refined copper	$587 million
• copper and alloy wire	$294 million
• copper anodes and matte	$258 million
• concentrates	$85 million
• recyclables	$66 million

The groupings of copper and copper alloy items for which Canada has a significant negative trade balance (export revenues less import revenues) are shown below:

• flat products (sheet, plate strips)	$100 million
• bars, rods and hollow sections	$88 million
• fabricated products	$78 million
• fittings	$52 million

CANADIAN PRODUCTION SUMMARY

The locations of Canadian mines and prospective producers are shown in Figure 5.

Canadian production of copper in concentrates was 600 200 t[g] (633 500 t)[h] as prices continued to languish between US$1421 and US$1690/t (US64¢ and 77¢/lb). Refined production declined to 567 700 t (579 700 t), reflecting the shortage of refinery feed due to the closure of a smelter and a strike at another smelter during 2002. Domestic shipments of refined copper remained nearly unchanged at 257 100 t (257 200 t). The reader can refer to monthly data for 2002 and 2001 by referring to the publication *Production of Canada's Leading Minerals*, Table 3, at http://mmsd1.mms.nrcan.gc.ca/mmsd/data/2002/02mtly12.pdf.

Existing and future Canadian copper production is affected both by copper prices and by the prices of other co-product and by-product metals. The present low prices of copper and other associated metals are not sufficient to maintain Canadian copper output at current levels to the end of the decade. The author projects that in six to eight years Canadian copper mine output will be less than

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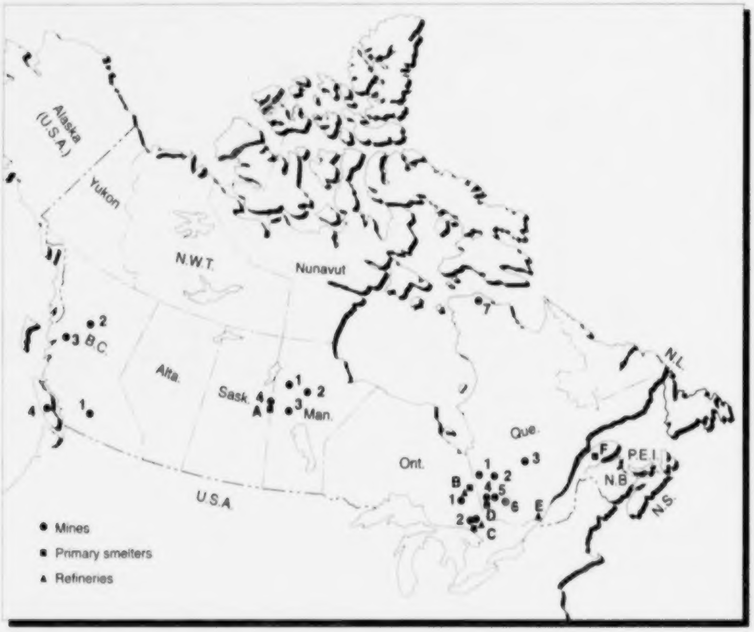
[f] Only groups generating over $50 million were shown in this table and the subsequent table.

[g] Data are rounded to the nearest 100 t.

[h] Data in parentheses indicate a comparable period in 2001.

Figure 5
Copper Producers in Canada, 2002



Numbers refer to locations on map above.

MINES

BRITISH COLUMBIA

1. Highland Valley Copper
2. Northgate Exploration Limited (Kemess)
3. Imperial Metals Corporation (Huckleberry)
4. Boliden AB (Myra Falls)

SASKATCHEWAN

Hudson Bay Mining and Smelting Co., Limited (Flin Flon)

MANITOBA

1. Hudson Bay Mining and Smelting Co., Limited (Ruttan mine)
2. Inco Limited (Thompson mine)
3. Hudson Bay Mining and Smelting Co., Limited (Chisel North mine)
4. Hudson Bay Mining and Smelting Co., Limited (Flin Flon area mines including Konuto Lake)

ONTARIO

1. Falconbridge Limited (Kidd Creek mines, Timmins)
2. Falconbridge Limited (Sudbury area) Inco Limited (Sudbury area)

QUEBEC

1. Les Mines Selbaie
2. Noranda Inc. (Bell-Allard mine)
3. Campbell Resources Inc. (Joe Mann mine) Inmet Mining Corp. (Troilus mine)
4. Breakwater Resources Ltd. (Bouchard-Hébert mine)
5. Agnico-Eagle Mines Limited (La Ronde mine) Barrick Gold Corporation (Bousquet mine)
6. Aur Resources, Inc., Novicourt Inc., Teck Cominco Limited (Louvicourt mine)
7. Falconbridge Limited (Raglan mine)

NEW BRUNSWICK

Noranda Inc. (Brunswick mine)

PRIMARY SMELTERS

A. Hudson Bay Mining and Smelting Co., Limited (Flin Flon)
B. Falconbridge Limited (Timmins)
C. Inco Limited (Sudbury area)
Falconbridge Limited (Sudbury area)
D. Noranda Inc. (Noranda)
F. Noranda Inc. (Murdochville) - closed April 2002

REFINERIES

B. Falconbridge Limited (Timmins)
C. Inco Limited (Sudbury area)
E. Noranda Inc. (Montréal-East)

---

[1] Highland Valley Copper is a partnership of Teck Cominco Limited and BHP Billiton Plc.

current output as insufficient new mines are expected to be developed to replace the output from Canadian copper mines that are expected to exhaust their reserves by the end of the decade.

There are three types of copper mines in Canada: copper mines, co-product copper producers, and by-product copper producers.

Copper Mines

Canadian "copper mines" are those mines at which copper generates the main source of revenue. At such operations, while other metals can be important sources of revenues, such revenues are generally not a decisive factor in either maintaining the mine operation or in a decision to close the mine. The Louvicourt, Highland Valley Copper, and Hucklebery mines are examples of such operations.

Co-Product Copper Mines

In other mines, copper revenues, while significant, are not the principal source of revenue for the operation. Copper prices in such operations are a factor in making new investment decisions or, in the case of periods of low prices, in deciding whether to shut the operations temporarily. But the price of another metal or metals may earn more revenues than copper and these metals can therefore be more important than copper in the decision-making process. Examples of such operations would likely include the Myra Falls, Bouchard-Hébert, and Selbaie mines.

By-Product Copper Mines

At some mines, copper production is a relatively minor component in the revenue stream. For such operations, the price of copper is much less important in the decision-making process and such mines could continue to produce copper even at very low copper prices. Conversely, much higher copper prices may not make enough of a difference in revenue to make increased mine production a profitable investment. Examples of such operations may include the LaRonde, Joe Mann, Lac des Iles, and Brunswick mines.

New mine development continues to be restrained by low prices for copper and zinc. The major greenfield[i] mine development scheduled will be Voisey's Bay, a nickel-copper-cobalt deposit in Newfoundland and Labrador. This project is scheduled to commence shipping concentrate in 2006. A number of mines face exhaustion of reserves; the Bousquet gold mine closed in 2002 and Selbaie is expected to close in late 2003.

Production vs. Shipments

Canadian statistics include a report of "mine production" (which is actually mill or concentrator production) and is the total amount of copper produced in concentrates by Canadian mines. However, Canadian statistics also include a "production" figure, which is actually the total amount of copper contained in concentrates that is shipped from the mine site in a year. This measure of production is less widely used and is not consistent with the definitions used by the International Copper Study Group (ICSG); Canadian "mine production" data are consistent with the ICSG definition.

The reader needs to be careful to verify which definition is being used in Canadian statistics when viewing a particular table. For example, the record of "Mineral Production of Canada, by Province" presented at http://mmsd1.mms.nrcan.gc.ca/mmsd/production/2002/02pprod.pdf actually shows preliminary **shipment** data for 2002 and not the production of copper in concentrate for 2002.

Preliminary shipment data are estimated prior to the end of the year in question. Mine production data (noted above) are reported by producers after the month of production. Hence, at the time of writing, the 2002 production data are more accurate than the estimated preliminary shipment data are. Revisions to both the shipment data and the mine production data are completed in the subsequent year. Historically, Canadian statistical series show mine shipment data. Such data are useful to show the relative copper output between provinces.

The preliminary estimate for 2002 shipments of copper in concentrates was 577 000 t (less than the over 600 000 t of copper in concentrates reported as being produced in 2002). The production data are usually higher than shipments as production relates to the total content of copper in concentrates produced whereas the shipment data relate to the estimated recoverable copper in concentrates shipped. In certain instances, material produced at the end of one year may not be shipped until the next year, causing a further difference between the data series.

Companies may show production data that report the total amount of copper contained in the concentrates produced in a year or the "payable production" may be shown. The latter reflects the amount of copper for which the mine is paid by the custom smelter. The deduction reflects the inability of the smelters to achieve 100% recoverability of the copper in the feed material. For some operations that report payable production, it is possible to calculate the production of copper contained if one knows the tonnage of ore processed, the copper grade of the material processed, and the recovery factor at the mill.

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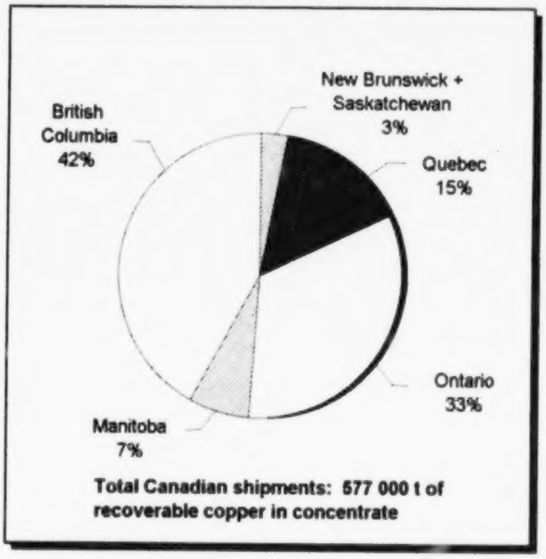
[i] A "greenfield" project is a project developed at an entirely new site; a "brownfield" project is an expansion at an existing or former production site.

Figure 6
Copper Output by Province, 2002



Source: Natural Resources Canada.

Using the shipment data, the largest producing provinces are British Columbia, with 42% of total copper shipments, and Ontario, with 33%. The majority of the B.C. output is from copper mines that also produce other by-products such as gold and molybdenum. The Ontario copper production comes in the form of by-product copper from the Sudbury Basin nickel operations and from the Kidd copper-zinc operations at Timmins (see Figure 4).

CANADIAN PRODUCTION FACILITIES

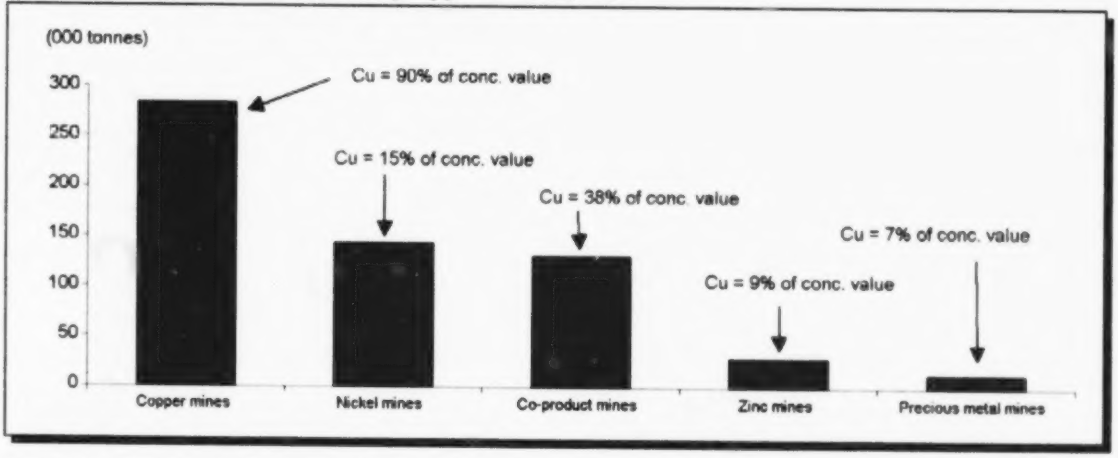
The web sites for Canadian copper producers and for companies that are prospective producers are shown in Table 3. Table 3 also presents the locations on the Internet where documents of publicly traded companies are filed with Canadian Securities Administrators. The System for Electronic Document Analysis and Retrieval, or SEDAR, presents data for public access.

Index of Canadian Producers by Company Name

Page

Agnico-Eagle Mines Limited 22.9
Aur Resources Inc. 22.9
Boliden AB 22.9
Breakwater Resources Ltd. 22.9
Barrick Gold Corporation 22.10

Figure 7
Canadian Copper Production, by Type of Mine, 2002



Sources: Company reports; author's criteria for grouping; average metal prices for 2002.
Notes: Total copper shown in graph equals 579 000 t. The total value of metals (copper, nickel, cobalt, etc.) in concentrates is estimated at US$3.3 billion. In addition, there is about US$325 million in platinum group metals production from Inco and Falconbridge from their worldwide sources that is not included in the graph. Conc. value = the sum of tonnage of each metal in concentrate multiplied by the average market price for that metal in 2002.

Campbell Resources Inc.	22.10
Falconbridge Limited	22.11
Highland Valley Copper	22.13
Hudson Bay Mining and Smelting Co., Limited	22.13
Imperial Metals Corporation	22.14
Inco Limited	22.15
Inmet Mining Corporation	22.16
Louvicourt Joint Venture	22.16
Noranda Inc.	22.17
North American Palladium Ltd.	22.18
Northgate Exploration Limited	22.19
Les Mines Selbaie	22.20

Agnico-Eagle Mines operates the LaRonde mine near Val-d'Or, Quebec, and is the operator of the **Louvicourt Joint Venture** (see below). Agnico-Eagle expanded its mill to 6350 t/d (7000 st/d) at its LaRonde operation in early October.[2] LaRonde is a gold operation that produces by-product silver, zinc and copper. Deep drilling during the year showed promising gold and copper values, and the company accelerated the development of drifts to allow further drilling. Agnico-Eagle was evaluating a number of options to mine ore below the Penna shaft (shaft depth is 2250 m or 7380 ft),[3] the deepest in the Western Hemisphere; one of the options is to sink a new shaft to 3050 m (10 000 ft).[4] Production increased with the new mill start-up and with higher grades. Production in 2003 is expected to be even higher as the new mill should be utilized for the entire year. The production data in 2002 and 2001 were:[5]

LARONDE MINE

	2001	2002
Millions of tonnes milled	1.57	1.78
Copper grade (%)	0.21	0.34
Copper recovery (%)	60.4	72.0
Contained copper (t)	2 140	4 630
Payable copper (t)	1 860	4 050
Payable zinc (t)	57 300	49 000
Payable gold (kg)	7 300	8 090
Payable silver (t)	78.5	96.2

Notes: Except for % figures, data are rounded to three significant digits. Contained copper is calculated.

Aur Resources Inc. is the operator of the Louvicourt mine (see below for details), a joint venture between Aur Resources (30%), Novicourt Inc. (45%) and Teck Cominco Limited (25%). This mine is expected to be depleted in mid-2005 at which time Aur hopes to have its Duck Pond project in production. Details about the Louvicourt mine are presented below.

Boliden AB redomiciled its operations in Sweden from Canada in late 2001.[6] Boliden owns the mine at Myra Falls through its subsidiary, Boliden Westmin (Canada) Limited.[7] Myra Falls is located on Vancouver Island in British Columbia. The latter company operates the underground zinc-copper mine, which has by-product gold and silver production. The Myra Falls operation consists of two underground mines and a mill; the H-W mine is located at a depth of 300-600 m and the Battle/Gap mine, with its higher zinc grade, is located about 2 km horizontally away from the shaft at a depth of 700-900 m. The ore from the two mines is hoisted in a 715-m shaft. The 1.4-Mt/y mill utilizes rod and ball mills and flotation to produce a zinc concentrate and a copper-gold concentrate, as well as a separate gold concentrate. The concentrates are trucked 90 km to the port at Campbell River for shipping to smelters, principally in Japan.[8] Zinc concentrates are sent to South Korea and Japan with some sales elsewhere. The mine reserves are sufficient for about eight years of future production,[9] or until about 2010.

Production at Myra Falls in 2002 was lower than in 2001 because the mine had been shut from December 2001 to the end of March 2002[10] following a write-down of 1.2 billion SEK[11] (or about US$120 million). Boliden was able to increase efficiency and reduce costs by 20% at the operation and, by the end of 2002, Boliden was making a profit from the Myra Falls operation.[12] Part of the cost reduction came from employees who voted to link wages to metal price trends, resulting in a 10% wage cut in 2002.[13] The number of Canadian employees at Boliden decreased from 432 at the end of 2001 to 363 at the end of 2002.[14]

Production from Myra Falls in 2001 and 2002 was:[15]

MYRA FALLS MINE

	2001	2002
Copper (t)	13 200	6 780
Zinc (t)	57 900	50 400
Gold (kg)	632	618
Silver (t)	12.1	18.7

Notes: Metal values are rounded to three significant digits. Metal tonnages are assumed to be payable.

Breakwater Resources Ltd. has two underground zinc-copper mines in Quebec: the Langlois mine and the Bouchard-Hébert mine. The Langlois mine did not operate in 2002; further details on this mine can be found in the "Projects and Mines on Standby in 2002" section of this chapter (below).

Breakwater's Bouchard-Hébert underground zinc mine (formerly known as the Mobrun mine) is located about 30 km away from Rouyn-Noranda (where Noranda's

Horne copper smelter is located). As well as zinc, the mine produces by-product gold, copper and silver. The copper concentrate grades 16-17% copper. A semi-autogenous (SAG) mill with conventional flotation processing is used in the concentrator.[16] During 2002, the upper sections of the mine were worked where the zinc grade is higher but the copper and precious metal grades are lower.[17] Capital expenditures of less than $2 million were incurred in 2002, as in 2001, but no additional capital expenditures are planned for the life of the mine.[18] The mine is slated to close in 2005 unless additional reserves are added.[19] Breakwater anticipates re-opening the Langlois mine to replace production from the exhaustion of the Bouchard-Hébert mine.[20]

The production data from the Bouchard-Hébert mine in 2002 and 2001 are shown below:[21]

BOUCHARD-HÉBERT MINE

	2001	2002
Millions of tonnes milled	1.04	1.05
Copper grade (%)	0.80	0.70
Copper recovery (%)	16.5	16.1
Contained copper (t)	6 930	6 060
Contained zinc (t)	41 200	51 200
Contained gold (kg)	886	626
Contained silver (t)	17.5	13.9

Notes: Data are rounded to three significant digits.
Contained copper is calculated.

A description of the Bouchard-Hébert mine and its geology can be found in Breakwater's Preliminary Prospectus, February 18, 2002, pp. 21-30, obtainable at www.sedar.com/csfsprod/data29/filings/00413572/00000003/C%3A%5CSEDAR%5CFILINGS%5CSR KTR2.pdf.

Barrick Gold Corporation produced some by-product copper from its Bousquet gold mine in Quebec.[22] Barrick reported that this mine was closed in 2002,[23] as had been previewed, and did not release copper production data for the mine. Human Resources Development Canada reported early in 2002 that the Bousquet mine would be closed in November 2002 and that 300 jobs would be lost.[24] Barrick's web site is located at www.barrick.com.

Campbell Resources Inc. operates the Joe Mann mine, an underground gold-copper mine, through its wholly owned subsidiary, **Meston Resources Inc.**.[25] Located about 65 km from Chibougamau, Quebec, the mine had been suspended due to a combination of ground control problems, dilution and low prices; the suspensions were from October 1999 to April 2000 and again from November 2001[26] to April 1, 2002.[27] The plan that brought the mine back into production was based upon an operating rate of 945 t/d, five days a week, to produce 2 t/y of gold, about 685 kg/y of silver and 558 t/y of copper (either in concentrates or as payable copper).[28] In addition, workers accepted wage reductions linked to the price of gold. The mine shaft is capable of hoisting 1815 t/d based upon a 12-hour hoist day.[29] The mine is scheduled to produce 408 t of copper in 2003[30] with the mine going to a five-day-per-week schedule in early 2003.[31] Ore is trucked to the Campbell mill located about 65 km from the Joe Mann mine.[32] The 3175-t/d mill has three circuits for metals recovery – gravity, flotation and cyanide are all used. Some of the gold is contained in the copper concentrate, which is railed to Noranda's Horne smelter.[33] During 2003, a technique of thermal fragmentation will be introduced in order to more efficiently mine narrow gold-bearing veins where dilution would make traditional methods uneconomic.[34]

Production in 2001 and 2002 (converted from the Imperial unit of measurement to the International System units) was:[35]

JOE MANN MINE

	2001	2002
Tonnes milled	–	122 000
Copper grade (%)	–	26
Contained copper (t)	–	300
Copper produced (t)	–	228
Gold produced (kg)	–	1 010

– Nil.
Notes: Data are rounded to three significant digits.
Contained copper is calculated. Production data are assumed to be "payable" values.

Noranda Inc. is the most significant copper producer in Canada. It also owns 59.5% of Falconbridge Limited (as of December 31, 2002), a company that produces a large amount of copper as a by-product of nickel from the company's Sudbury operations and as copper from the company's Kidd operations in Timmins, Ontario. Noranda's Canadian Copper and Recycling business unit consists of:

- the Kidd Creek mining operations at Timmins, Ontario;
- the Horne smelter at Rouyn-Noranda, Quebec;
- the Gaspé smelter (now permanently closed);
- the Kidd metallurgical complex, consisting of a copper smelter and copper refinery (as well as a zinc refinery, acid plant and recovery facilities for minor metals); and
- the CCR refinery in Montréal-East.

The details of Noranda's non-Falconbridge operations are shown below.

Noranda has direct interests in many copper production facilities in Canada, including nine mines,[j] three smelters (of which one closed in 2002), and two refineries. In addition, the company has significant copper production facilities in foreign countries.[k]

Falconbridge is owned 59.5% by Noranda.[36] In Canada, Falconbridge has nickel-copper production facilities as well as copper-zinc production facilities. These are detailed separately below.

Falconbridge's smelter in Sudbury, Ontario, takes concentrate produced from the company's mines located in Sudbury (four mines) and northern Quebec (one mine), plus material that is recovered from recyclables (1800 t of copper were recovered from recyclables in 2001). The mines ship their ore to a central mill at Strathcona where most of the ore is processed into a bulk nickel-copper-cobalt concentrate. In addition, however, some high-grade copper material is recovered separately as copper concentrate and shipped to Falconbridge's Kidd operations for recovery (see below). The bulk nickel-copper-cobalt concentrate from the Sudbury mines is sent to the company's smelter, located at Falconbridge, Ontario, about 85 km from the Strathcona mill. This concentrate is smelted to a nickel-copper-cobalt matte and shipped to the Nikkelverk refinery in Kristiansand, Norway, for final refining.[37]

The copper in bulk nickel-copper concentrates and copper contained in recyclable materials is smelted at Falconbridge's electric smelter in the Sudbury Basin. In 2001, Falconbridge recycled 537 t of copper at its Sudbury smelter.[38] The smelter output was:[39]

FALCONBRIDGE SMELTER OUTPUT

	2001	2002
	(tonnes)	
FALCONBRIDGE SMELTER OUTPUT		
Copper in matte		
Sudbury origin	8 890	11 200
Raglan origin	7 160	6 620
Custom origin	1 840	2 740
Nickel in matte		
Sudbury origin	24 500	28 200
Raglan origin	26 900	25 200
Custom origin	3 440	4 400
Cobalt in matte		
Sudbury origin	590	691
Raglan origin	419	370
Custom origin	779	894
Sulphuric acid	225 000	247 000

Notes: Metal values are rounded to three significant digits. Custom nickel is nickel from recyclable feeds.

While Falconbridge's electric smelter has operated below capacity for the last couple of years due to a shortage of feed, in the fourth quarter the smelter operated at a record rate of 72 000 t/y of nickel in matte compared to its previous rated capacity of 65 000 t/y of nickel in matte.[40] The smelter has a feed capacity of 130 000 t/y of matte.[41] The smelter's acid plant converts sulphur dioxide from exhaust gas to sulphuric acid, which is sold. The capacity of this acid plant is about 300 000 t/y.[42] In February, the province issued a new order limiting the annual emission of sulphur dioxide from Falconbridge's smelter to 66 000 t/y effective December 31, 2006 (down from the previous limit of 100 000 t/y), and reducing ground-level concentrations to 0.34 ppm effective April 2002. In 2001, the smelter emitted 29 600 t of sulphur dioxide, less than 30% of the allowable limit.

Falconbridge has permission from the Province of Ontario to export nickel-copper matte from Canada with a recoverable content of 100 million lb (or about 45 360 t) of refined nickel annually; this permission lasts until December 31, 2009.[43] The permission has been renewed a number of times in the past and can be renewed again in the future.

Falconbridge's copper production in Canada from nickel operations in 2001 and 2002 is shown below:[44]

FALCONBRIDGE INO

	2001	2002
SUDBURY MINES		
Millions of tonnes milled	1.95	2.30
Copper grade (%)	1.35	1.56
Copper recovery (%)	87	87
Contained copper in nickel-copper conc. (t)	8 850	9 380
Contained copper in copper conc. (t)	14 000	21 700
Contained nickel (t)	25 200	27 800
Contained copper (kg)	630	690
Contained gold+silver+platinum group metals (kg)	..	..
RAGLAN MINE		
Millions of tonnes milled	0.96	0.87
Copper grade (%)	0.91	0.97
Copper recovery (%)	79	77
Contained copper (t)	6 920	6 500
Contained nickel (t)	24 600	24 600
Contained copper (kg)	318	386
Contained gold+silver+platinum group metals (kg)	..	..

INO = Integrated nickel operations; . . Not available.
Notes: Data are rounded to three significant digits. Recovery of copper is calculated from tonnes milled and head grade.

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[j] Bell-Allard, Brunswick and Kidd Creek (considered as one mining complex), Sudbury (4), Raglan, and Louvicourt.

[k] For example, Antamina, Colahuasi, Lomas Bayas and Altonorte.

Fed from the copper production from the nickel operations located in Canada, Falconbridge produces refined copper at its plant in Norway. The Falconbridge Nikkelverk Aktieselskap A/S operation is located in Kristiansand in southern Norway. There Falconbridge recovers nickel, cobalt, gold, silver, platinum group metals and sulphuric acid by treating the matte with a chlorine leach and electrowinning. Nikkelverk supplements the feed from the Sudbury smelter by tolling, principally from BCL Limited in Botswana. Finally, Nikkelverk can process certain recyclable materials as well. The capacity of Nikkelverk is 40 000 t/y of copper, 85 000 t/y of nickel, and 4500 t/y of cobalt.[45] This could be increased, if market conditions and feed supply warrant, to 60 000 t/y of copper, 100 000 t/y of nickel and 5000 t/y of cobalt.[46] Nikkelverk's production in 2001 and 2002 was:[47]

FALCONBRIDGE REFINERY OUTPUT

	2001	2002
Refined copper (t)		
Sudbury origin	7 140	11 100
Raglan origin	7 820	6 740
Custom origin	11 800	12 800
Refined nickel (t)		
Sudbury origin	22 100	27 200
Raglan origin	29 400	24 300
Custom origin	16 800	17 100
Refined cobalt (t)		
Sudbury origin	496	621
Raglan origin	439	344
Custom origin	2 379	3 030
Platinum group metals (kg)	7 280	11 000
Sulphuric acid (t)	86 400	89 900

Notes: Metal values are rounded to three significant digits.
Refinery is located in Norway.

The Kidd operations of Falconbridge consist of two independent divisions: the Kidd Mining Division, site of the company's underground mines producing copper, zinc and silver; and the Kidd Metallurgical Division, located about 25 km southwest of the mine, where the company mills the ore, smelts the copper concentrate, refines the anode copper, and refines the zinc concentrate. It also produces by-product cadmium, indium and sulphuric acid. Silver and other by-products contained in the electro-refinery tank house slimes are sent to Noranda's CCR Division for recovery. The nearly 700 workers at the Kidd metallurgical site represented by Local 599 of the National Automobile, Aerospace and Agricultural Implement Workers Union of Canada (CAW-Canada) signed a three-year labour agreement with Falconbridge in September[48] that replaced the agreement that expired on September 30.[49] Falconbridge is working with Noranda's Horne smelter and CCR refinery to coordinate operations and feed procurement and to pool technical resources[50] in order to reduce costs.

Ore is produced from three mines at the Kidd mining site: the No. 1, No. 2 and No. 3 mines. These mines divide the orebody up into three horizontal slices like thick layers of a cake. Mine No. 1 extends from surface to 790 m, Mine No. 2 extends from 790 m to 1400 m, and Mine No. 3 extends from 1400 m to 2070 m.[51] Mine D, under development, will produce from a zone located at a depth of 2070-3110 m.[52] By year-end 2002, about 40% of the $640 million project had been completed.[53]

Mine No. 3 was brought into production in late 2001.[54] The development of Mine D was accelerated in 2001 after ground control problems in existing mining areas;[55] ongoing work in 2002 included shaft-sinking and ramp development. A new ventilation system for Mine D and the existing mine operation was installed and started up in the third quarter.[56] Mine D is scheduled to begin production in late 2004; the $650 million project will extend the life of the Kidd mine to 2024 by allowing mining of 10 Mt of reserves, access to 14 Mt of resources,[57] and the mine to return to its production level of 2.4 Mt/y of ore.[58]

Mine production at Kidd in 2001 and 2002 was:[59]

KIDD MINE PRODUCTION

	Tonnes	Copper Grade	Zinc Grade	Silver
		(%)	(%)	(g/t)
2001				
Mine No. 1	703 000	1.80	6.75	78
Mine No. 2	281 000	4.05	0.25	22
Mine No. 3	993 000	2.11	5.98	61
2002				
Mine No. 1	992 000	1.80	7.78	92
Mine No. 2	216 000	2.87	0.99	27
Mine No. 3	1 110 000	2.11	5.89	78

The copper concentrate is smelted at the Kidd metallurgical site in a Mitsubishi continuous smelter with a capacity of 150 000 t/y of blister copper (copper in anodes),[60] along with the copper concentrate produced at the separate circuit in the Strathcona mill (see above) and the custom concentrates, which include imported copper in concentrate.[61]

In addition, the smelter processes copper concentrates from Falconbridge's Collahuasi mine in Chile[62] and from Minera Escondida Limitada,[63] also located in Chile. Production in 2001 and 2002 was:[64]

KIDD METALLURGICAL DIVISION

	2001	2002
Millions of tonnes milled	1.95	2.24
Copper grade (%)	2.31	2.12
Copper recovery (%)	94	95
Contained copper (t)	42 300	45 400
Contained zinc (t)	81 700	104 000
Contained silver (t)	89	114
Anode copper (t)		
from Kidd mine	46 000	44 500
from Falconbridge INO	8 430	23 100
from custom feed	77 600	76 500
Cathode copper (t)		
from Kidd mine	41 800	47 000
from Falconbridge INO	8 430	23 100
from custom feed	77 600	76 500
Zinc in Kidd concentrate (t)	81 700	104 000
Refined zinc (t)	140 000	145 000
Sulphuric acid (t)	514 000	584 000

Notes: Metal values are rounded to three significant digits. Copper recovery rate and contained copper are calculated. Metal production and metal in concentrates are rounded to three significant digits. Custom material = copper in imported concentrates plus domestic and imported scrap. Zinc and silver contents of custom material are not shown.

In addition, the Kidd refinery sends anode slimes containing substantial quantities of silver to Noranda's CCR refinery and to third-party refineries.[65] Refined output for 2003 was reported by Falconbridge in its 2002 Annual Report at 132 000 t of copper and 145 000 t of zinc.[66]

Highland Valley Copper is owned 63.9% by Teck Cominco Limited, 33.6% by BHP Billiton Plc, and 2.5% by Highmont Mining Company.[67] The open-pit mine is located about 80 km southwest of Kamloops, British Columbia. The 136 000-t/d concentrator produces a copper concentrate and a molybdenum concentrate using SAG mills and conventional flotation technology.[68] The concentrate is relatively high grade due to a significant percentage of bornite in the ore. The mine was closed for four months during 1999 and it resumed work after negotiating a power contract tying power rates to copper prices and after signing a collective agreement with workers that reduces wages if copper prices fall below US67¢/lb and that increases wages if prices rise above US79¢/lb; the labour agreement contract with the workers expires on September 30, 2003.[69] Bargaining for the new labour contract is planned to commence in mid-2003.[70]

During 2002, there were reports that BHP Billiton was considering selling its share of Highland Valley Copper.[71] The A V Birla Group was reported to have been in negotiations with BHP Billiton, but no official confirmation was given by either company.[72] In August, after 18 months of public review, Highland Valley Copper received a permit from the Province of British Columbia to divert groundwater into a creek; the drainage will help stabilize the pit walls enabling the mine to stay in operation until 2009.[73] Ore reserves at the end of 2002 were sufficient for six years of current operations,[74] namely to the end of 2008. The production for 2001 and 2002 was:[75]

HIGHLAND VALLEY COPPER MINE

	2001	2002
Millions of tonnes milled	48.90	49.90
Copper grade (%)	0.43	0.41
Copper recovery (%)	89.4	88.7
Contained copper (t)	187 000	181 000
Payable molybdenum (t)	. .	2 500
Payable silver (t)	. .	62.2
Payable gold (kg)	. .	457

. . Not available.
Note: Data are rounded to three significant digits.

At the end of 2002, the **Hudson Bay Bay Mining and Smelting Co., Limited (HBMS)** operations of **Anglo American plc** consisted of four mines, a mine under development, two mills, a copper smelter, and a zinc pressure leach refinery. The main operations are centred on the Manitoba/Saskatchewan border. The principal mines were Konuto, Chisel North (a zinc mine), Callinan, Trout Lake, and the new 777 mine. All facilities are in Manitoba except for the Konuto and Callinan mines, which are located in Saskatchewan close to the border with Manitoba.[76] As announced in October 2001, the company's Ruttan mine and mill in the town of Leaf Rapids, Manitoba, were closed on June 26, 2002;[77] the closure resulted in the layoff of about 350 workers.[78]

In 1999, HBMS announced a US$240 million expansion, which included the Chisel North mine in Snow Lake, Manitoba, the 777 mine at Flin Flon, an expansion of the Flin Flon mill, and an expansion of the zinc plant.[79] The 777 shaft was sunk in July 2002 to a depth of 1540 m[80] and was equipped by year-end 2003. Lateral development at the 777 mine is planned during 2003 and full production of 1 Mt/y from the new mine is anticipated in August 2004.[81] The 777 mine should extend the life of the operations to 2016.[82] The mineable reserves and resources of the 777 orebody were estimated at 14.2 Mt grading 2.53% copper and 5.09% zinc.[83]

The current cost estimate of the expansion is US$276 million.[84] The Flin Flon metallurgical facilities also process purchased concentrates; the copper concentrates have been sourced both domestically and internationally but, in the past couple of years, have only been sourced domestically.

During 2002, HBMS operated the Ruttan, Konuto, Callinan and Chisel North mines; the former closed in mid-year as noted, while the latter is a zinc mine with no copper. The Konuto and Callinan mines are both located in Saskatchewan, close to the Manitoba border.[85] From its own mines, HBMS produced 42 900 t of copper compared to 102 100 t of zinc.[86] In addition to copper and zinc production, gold and silver are recovered from the company's mines and from purchased concentrates. The production in 2001 and 2002 is shown below:[87]

HBMS, ALL PROPERTIES

	2001	2002
Millions of tonnes milled	3.56	3.00
Copper grade (%)	1.50	1.70
Copper in concentrates (t)	53 100	42 900
Copper in anodes (t)	79 500	83 400
Zinc in concentrates (t)	78 400	102 000
Refined zinc production (t)	88 400	108 000
Gold produced (kg)	2 150	1 840
Silver produced (t)	37.7	38.4

Notes: Data are rounded to three significant digits. Copper in anodes includes copper from custom concentrate. Gold and silver production is assumed to be payable. Zinc, gold and silver production is assumed to include metal from purchased concentrates.

Imperial Metals Corporation is a new corporation; it was formed in 2002 after the former Imperial Metals Corporation was reorganized into two distinct businesses, one to focus on energy and one to focus on mining.[88] The natural gas and oil assets were renamed IEI Energy Inc. and the mining assets were transferred to the new Imperial Metals Corporation effective January 1, 2002.[89] Imperial Metals' mining assets include a 50% interest in the Huckleberry mine (see below), an open-pit copper-molybdenum mine, and the Mount Polley mine, which is an open pit copper-gold operation that has been closed since September 2001 due to low metal prices[90] (see Projects section below).

Huckleberry Mines Ltd., owned 50% by Imperial Metals Corporation and 50% by the "Japan Group," is the operator of the Huckleberry mine. The Japan Group consists of Mitsubishi Materials Corporation, Dowa Mining Co., Ltd., Furukawa Co. Ltd., and Marubeni Corporation. The Japan Group initially had a 40% interest earned by providing US$60 million in financing in 1996. This was increased to 50% in mid-1999.[91]

In 2002, Imperial Metals continued discussions with lenders about restructuring fixed payments due under existing loans to payments that could be made when and as cash were to be available over the course of the remaining mine life.[92] The company reported that the payment date for all deferred principal and interest charges has been rescheduled to June 30, 2003, to provide time for a restructuring agreement to be negotiated. If negotiations fail, then Imperial Metals' interest in the mine could be foreclosed.[93] The deferred principal and interest payable on June 30 amounts to $64 million, which Huckleberry Mines Ltd. will be unable to pay. The financial obligations of Huckleberry Mines are non-recourse to Imperial Metals.[94]

The Main Zone pit was mined out in April after having commenced in November 1999. The mining has been subsequently sourced entirely from the East Zone pit. This pit had been redesigned based upon a long-term copper price of US85¢/lb, down from the earlier design, which used a price of US$1.00/lb. The ore is judged adequate to maintain production through 2007. Molybdenum recovery from the East Zone pit is much lower than from the Main Zone pit and lower molybdenum production is expected for the rest of the mine life.[95] The East Zone probable reserves also contain gold and silver values, but production data for these metals have not been released.[96] Using the average reserve grade and a recovery of 88%, copper production would average about 32 000 t/y of copper in concentrates over the remaining life of the mine.

Huckleberry's copper concentrate is trucked to Stewart, British Columbia, and then shipped to Japan; the molybdenum concentrates are trucked to Vancouver for sale.[97] The production data in 2002 and 2001 are shown below:[98]

HUCKLEBERRY MINE

	2001	2002
Millions of tonnes milled	7.42	7.42
Copper grade (%)	0.52	0.53
Copper recovery (%)	94	88
Copper production (t)	36 400	35 000
Molybdenum production (t)	888	507

Note: Data are rounded to three significant digits.

Inco Limited operates mines, mills, smelters and refineries in Sudbury, Ontario; Port Colborne, Ontario; and Thompson, Manitoba. The company produces copper as a by-product of its nickel operations. In addition, cobalt, gold, silver, platinum group metals, selenium, tellurium, sulphuric acid and liquid SO_2 are also produced at Inco's Canadian facilities. The majority of the copper produced in Inco's Canadian facilities is from the Sudbury mines; 94% of the total copper output in 2002 came from Sudbury ores while only 1% came from Thompson ores. The remaining 5% of the copper produced may have come from recyclable materials, likely also containing nickel. Inco no longer smelts copper concentrate from Thompson ores in Thompson, but sends the concentrate to Sudbury for smelting.[99]

A bulk nickel-copper concentrate is produced in Sudbury at the Clarabelle mill in Copper Cliff, Ontario. The concentrate is sent to two flash smelters and then to convertors; the Bessemer matte is slowly cooled over a period of days to allow the copper and nickel to separate. The cooled matte is then crushed and ground and, through both magnetic and conventional separation, the copper concentrate is removed and sent to Inco's MK Convertor. The copper concentrate is then smelted in a series of stages: the copper is cast into anodes and refined at Inco's copper refinery in Copper Cliff.[100] Production of refined copper was 113 116 t in 2002, compared to 116 255 t in 2001, and below the targeted 125 000 t for 2002 due to various problems in the Ontario Division, including ground instability.[101] About 3% of Inco's sales in 2002 were derived from purchased materials.[102]

Inco does not publish its mine concentrate grades or its recoveries in its financial publications. However, data on the percentage of copper, cobalt and precious metals from the Ontario and Manitoba ores are shown in the company's 10-K reports.[103] The Cobalt Development Institute reports Inco's total cobalt production.[104] Inco's estimated production of finished metals derived from Canadian sources and imported concentrates was:[105]

INCO, ONTARIO AND MANITOBA

	2001	2002
Tonnes mined (Mt)	9.48	9.66
Copper grade (%)	1.37	1.28
Nickel grade (%)	1.75	1.64
Copper refined from Ontario and Manitoba mines (t)	109 000	106 000
Nickel produced in Ontario and Manitoba mines net of purchased feed (t)	128 000	130 000
Cobalt from Ontario and Manitoba mines (t)	1 250	1 290

Note: Metal values are rounded to three significant digits.

During 2001 and 2002, Inco purchased nickel feed that was processed in its Canadian operations. The tonnages of nickel derived from these sources amounted to about 16 800 t in 2001 and 17 200 t in 2002.[106]

Also in 2001 and 2002, Inco's deliveries of gold and silver from non-toll refined sources are reported. These deliveries exceed the gold and silver production from Canadian mines by the amount of gold and silver in purchased recyclables and primary feed, data which are not released. The deliveries of platinum group metals, gold and silver were:[107]

INCO, PLATINUM GROUP METALS, GOLD AND SILVER DELIVERIES

	2001	2002
Platinum group metals deliveries (kg)	12 600	13 400
Gold deliveries (kg)	2 360	2 210
Silver deliveries (t)	49.7	48.8

Notes: Non-toll refined sources. Data are rounded to three significant digits.

The composition of Inco's 2002 platinum group metals production was shown in a presentation to the investment community in February 2003 as 52% palladium, 44% platinum and 4% rhodium plus ruthenium and iridium.

INCO, COMPOSITION OF PLATINUM GROUP METALS PRODUCTION

	2001	2002
	(kg)	
Platinum	5 500	5 880
Palladium	6 410	7 000
Rhodium	404	404
Ruthenium	124	31.1
Iridium	156	93.3
Total	12 600	13 400

Note: Totals do not add due to independent rounding to three significant digits.

Drilling of the 170 orebody at the McCreedy/Lower Coleman mine in 2002 added 1.6 Mt grading 7.7% copper, 1.0% nickel, and 15.9 g/t of precious metals (platinum, palladium and gold) to ore reserves; additional drilling is planned in 2003.[108]

Inco's forecast copper production for 2003 is 114 000 t, of which 46% is forecast to be produced in the first half of the year.[109]

Inmet Mining Corporation operates its wholly owned[110] open-pit Troilus gold mine 175 km north of Chibougamau, Quebec; it produces by-product copper. In the first nine months of 2002, gold accounted for 82% of the value of the metal production.[111] The ore grades 1.1 g/t gold and 0.2% copper; mill recovery was 92% for copper in 2001.[112] The operation produces a copper concentrate and gold doré. The copper concentrate is sold under long-term contract to an unnamed third-party smelter.[113] The Troilus mill has been expanded every year since production began in 1977.[114]

Improvements in the mill in 2002 and 2001 allowed a higher throughput, which reduced cash costs significantly.[115] In 2001, the mine processed higher-grade ore and stockpiled lower-grade ore to be processed at the end of the mine life, which in 2002 was expected to be 2006.[116] (Note: Inmet announced revalued ore reserves at Troilus in March 2003, putting the final year of production back to 2010 because of in-fill drilling to better delineate reserves and because of improved operational efficiencies.)[117] A bulk sampling program from the J-4 deposit was begun in late 2002 to determine the economics of mining; J-4 was targeted as the source of ore from 2004 to 2006.[118]

Increased mill throughput at Troilus reduced the production costs per tonne as the mill throughput went from less than 11 000 t/d in 1998 to 15 000 t/d in 2001. In 2002, mill throughput increased by over 4% to 5.7 Mt (equivalent to nearly 15 700 t/d per calendar day).[119] Reduced costs were a significant factor in allowing the increase in reserves noted above, which will extend the mine life to 2010.

The production of the by-product copper in concentrate in 2001 and 2002 was 7800 t and 6800 t, respectively.[120] It appears that, with the ore grades and recovery factors, the tonnages above represent payable copper and not copper contained in concentrate; using reported 2001 data of 5.49 Mt milled at 0.2% copper and 92% copper recovery in the mill, the tonnage of copper contained in concentrates would have amounted to about 10 100 t.[121]

Production in 2001 and 2002 was:[122]

TROILUS MINE

	2001	2002
Millions of tonnes milled	5.49	5.73
Copper grade (%) (e)	0.16	0.13
Copper recovery (%)	92	90
Copper production (t)	7 800	6 800
Contained gold (kg)	5 060	5 130

(e) Estimated.

Notes: Data for gold production and tonnes milled are rounded to three significant digits. Copper grade is estimated using recovery, ore tonnage and copper production; stated grades for 2001 and 2002 were 0.2% and 0.1%, respectively. Copper production is available only to nearest 100 t.

The reserves for year-end 2002, as revalued in the March 2003 announcement, were 42.5 Mt grading 0.9 g/t gold and 0.09% copper (proved plus probable), compared to the pre-revision year-end 2002 total of 22.6 Mt grading 0.9 g/t gold and 0.1% copper.[123]

The **Louvicourt mine** is a copper mine producing by-product zinc, silver and gold that is owned jointly by Novicourt Inc. (45%), Aur Resources Inc. (30%) and Teck Cominco Limited (25%).[124] Noranda Inc. had a beneficial interest of 62.1% in Novicourt in 2002, up from 61.4% in 2001.[125] There are no full-time employees of Novicourt; Noranda supplies the administrative, accounting and other corporate services under an agreement between the two companies. Novicourt is represented on the management board of Louvicourt by Noranda appointees. Novicourt sells its 45% share of zinc and copper concentrates to Noranda at terms and conditions similar to those negotiated by Aur and Teck Cominco for their respective shares of output.[126]

Difficult ground conditions were experienced in 2002 as the mine continued to deplete its reserves.[127] In January, a ground fall of about 100 000 t of ore and backfill in an active production area resulted in increased ground support costs and the postponement of mining higher-grade ore.[128] The mine produces separate copper and zinc concentrates. In addition to the copper and by-product zinc, the mine also obtains revenue from gold and silver contained in the concentrate. The production data in 2002 and 2001 are shown below:[129]

LOUVICOURT MINE

	2001	2002
Millions of tonnes milled	1.57	1.48
Copper grade (%)	3.40	3.10
Copper recovery (%)	96.90	96.80
Contained copper (t)	51 700	44 900
Contained zinc (t)	17 700	20 000
Contained silver (t)	28	23
Contained gold (kg)	1 040	865

Note: Data are rounded to three significant digits.

Louvicourt is expected to close by mid-2005 following exhaustion of economic reserves,[130] and ore production is scheduled to decline as the mine depletes its reserves. The mill is scheduled to operate at 3800 t/d in the first half of 2003 (compared to 4069 t/d in 2002 and 4304 t/d in 2001); in June, the mill rate will drop to 3000 t/d.[131] The head grade for the ore in 2003 is budgeted at 3.2% copper, 1.7% zinc, 24.4 g/t silver, and 0.73 g/t gold. Production in 2003 is budgeted at 37 600 t of copper contained in concentrate; by-product zinc production is scheduled to be 16 300 t, with silver forecast at 19.7 t and gold at 600 kg.[132]

Noranda Inc., as noted above, owns a majority share in Falconbridge Limited, whose operations were noted above. Brascan Corporation and associated companies own about 40% of Noranda common shares.[133] The copper operations of the non-Falconbridge facilities are detailed below. In June, Noranda and Falconbridge announced that certain copper activities would be rationalized, thereby jointly saving about $10 million.[134]

In 2002, Noranda's copper was derived from:

- two wholly owned[135] zinc operations, the Brunswick and Bell-Allard mines and mills, which produce by-product copper (Brunswick also produces refined lead at its smelter);
- two copper-zinc producers, the Louvicourt mine and mill (detailed above, in which Noranda is a part owner through a Noranda subsidiary), and the Kidd operations of Falconbridge Limited (detailed above) consisting of a mine complex, a mill, a copper smelter and refinery, an acid plant, and minor metal recovery facilities;
- nickel-copper operations (five mines, two mills, a smelter, and an acid plant) of Falconbridge in Sudbury and in northern Quebec (detailed above), which produce by-product copper;
- the Gaspé smelter;
- the Horne smelter; and
- the CCR refinery.

The Bell-Allard zinc mine is located 10 km from the town of Matagami, Quebec. Bell-Allard began operation in 2000 with five years of reserves,[136] using the Mattagami mill, located 2 km from the mine, to process ore. The conventional flotation mill produces a zinc concentrate and a copper concentrate that are sent to the CEZ refinery and the Horne smelter, respectively.[137,138] The Bell-Allard mine is scheduled to close in the fourth quarter of 2004. The nearby Perseverance zinc property (see Project section below), with copper by-product, will not come into production before the closure of Bell-Allard.[139] The tonnages mined in 2002 and 2001 were 669 000 t and 774 000 t,[140] respectively. Production at the Bell-Allard mine in 2001 and 2002 was:[141]

BELL-ALLARD MINE

	2001	2002
Millions of tonnes milled	0.77	0.67
Contained copper (t)	8 640	7 260
Contained zinc (t)	88 800	84 800
Contained silver (t)	12.30	10.20
Contained gold (kg)	?	?

Notes: Data are rounded to three significant digits. Gold is reported in reserves, but gold production is not shown by the company.

The Brunswick mine is located about 25 km from Bathurst, New Brunswick. This zinc mine also produces lead and by-product copper and silver. Copper concentrate from Brunswick is sent to the Horne smelter.[142] The mine produced its one hundred millionth tonne of ore in March 2003.[143] The Brunswick lead smelter will cease operating on a continuous basis from mid-2003 forward and will operate for eight months per year.[144] Two shafts provide access to the five mining levels to a depth of 1.1 km. Over 1 Mt of reserves were lost in 2002 due to poor ground conditions when a re-evaluation of mining plans was completed.[145]

Production in 2001 and 2002 was:[146]

BRUNSWICK MINE

	2001	2002
Millions of tonnes milled	3.60	3.49
Contained copper (t)	8 530	8 920
Contained zinc (t)	277 000	304 000
Contained lead (t)	76 200	83 100
Contained silver (t)	194	219

Note: Data are rounded to three significant digits.

The mine's reserves are expected to last until late 2008, assuming a mining rate of between 9000 and 10 000 t/d.[147]

The metallurgical processing plants of Noranda's Canadian Copper and Recycling business unit, which are not part of Falconbridge (see above), consist of:

- the Gaspé smelter (now permanently closed) at Murdochville, Quebec;
- the Horne smelter at Rouyn-Noranda, Quebec; and
- the CCR refinery in Montréal-Est.

In November 2001, Noranda had announced that its Gaspé smelter would close in April 2002 for a period of at least six months.[148] The mine at Gaspé had been closed in 1999 as reserves had been depleted 46 years after opening.[149] In late March 2002, Noranda announced that the closure of Gaspé by April 30, 2002, would be permanent.[150] The last casting of anode copper from the smelter was on April 27, 2002.[151] Copper anode production in 2001 had been 108 673 t.[152] The smelter is being dismantled and the company is remediating the plant site.[153] Production at the Gaspé smelter in 2001 and 2002 was:[154]

GASPÉ SMELTER

	2001	2002
Feed material (t)	327 000	100 000
of which recycled was (t)	21 000	2 000
Anode copper (t)	109 000	29 600
Sulphuric acid (t)	220 000	75 000

Note: Data are rounded to three significant digits, except for recycled feed, which is rounded to nearest 1000 t.

At the Horne smelter, workers belonging to the union *Syndicat des travailleurs de la Mine Noranda* went on strike on June 24 after the union and company were unable to agree upon the terms of a new labour contract. The previous contract had expired on February 28, 2002.[155] Noranda management personnel kept the smelter operating at a reduced rate, producing 147 020 t of copper anodes in 2002 compared to 188 145 t in 2001. Further talks between the union representing the 500 workers and the company did not result in an agreement. Noranda said that the smelter was running at 70% of capacity in November.[156] The smelter can process 850 000 t/y of material.[157] The Horne smelter produced 510 000 t of sulphuric acid in 2002, compared to 591 000 t in 2001.[158] The strike was not settled by the end of 2002. Production at the Horne smelter in 2001 and 2002 was:[159]

HORNE SMELTER

	2001	2002
Feed material (t)	841 000	734 000
of which recycled was (t)	75 000	45 000
Anode copper (t)	188 000	147 000
Sulphuric acid (t)	591 000	510 000

Note: Data are rounded to three significant digits, except for recycled feed, which is rounded to nearest 1000 t.

The CCR copper refinery is located in Montréal-Est, Quebec, on Montréal Island. This refinery handles copper anode from the Horne and Gaspé smelters, as well as anode from Noranda Inc.'s Altonorte smelter in Chile.[160] Altonorte is being expanded to 290 000 t/y of anode copper (it produced 147 000 t in 2002) recovered from third-party mines located in Chile. The US$170 million expansion[161] affords Noranda the opportunity to obtain new anode copper for Noranda's CCR refinery, compensating for the loss of the Gaspé smelter output.

As well as processing copper concentrates, the Horne smelter, with its Noranda reactor, can process complex and recyclable materials containing copper, gold, silver and platinum group metals. For example, scrap electrical wires are a source of copper. Used electronics are a source of gold, silver and platinum group elements. These materials are sent in the anode copper to the CCR refinery for final separation into their elemental forms.

The continued closure of the Gaspé smelter and the reduced output from the Horne smelter meant that Noranda's CCR refinery near Montréal, Quebec, produced 24% less refined copper in 2002 than in 2001. During the last quarter, the CCR work force was reduced by 15% due to increased efficiencies resulting from modernization.[162] Production at CCR in 2001 and 2002 was:[163]

CCR REFINERY

	2001	2002
Refined copper (t)	323 000	244 000
Refined silver (t)	1 340	1 260
Refined gold (t)	38.4	32.0

Note: Data are rounded to three significant digits.

CCR's production of selenium, tellurium and nickel sulphate is not disclosed.[164]

NorFalco LLC, owned 65% by Noranda Inc. and 35% by Falconbridge Limited, is part of Noranda's zinc business unit. NorFalco came into being when Noranda redeemed the 50% interest of E.I. du Pont de Nemours and Company in Noranda Dupont LLC, jointly owned by Dupont and Noranda until mid-2001. NorFalco purchases all of the sulphuric acid produced by Noranda and Falconbridge in North America for resale to customers. Sales in 2002 were about 2.1 Mt of sulphuric acid. The U.S. Department of Justice is investigating complaints that NorFalco, Falconbridge and Noranda conspired with others to artificially fix the price of sulphuric acid. These allegations have been denied. As of year-end 2002, the Department of Justice had not decided to bring charges or to terminate the investigation.[165]

North American Palladium Ltd. operates the Lac des Iles open-pit palladium mine 85 km north of Thunder Bay, Ontario. The concentrate also contains important amounts of by-product platinum, gold, copper and nickel. The mine was expanded in 2001 to 15 000 t/d and the company built a new mill to replace the older 2400-t/d mill. A secondary crushing circuit was completed in early 2002 in an attempt to increase the throughput to design capacity. However, in September, the company discovered that the primary crusher had sustained damage and it remained off-line through the end of the year, so the old crusher was brought back on-line and crushing services were temporarily contracted. A program of refining mill recoveries continued throughout the year. The concentrate is sent to Inco and Falconbridge in Sudbury for smelting and refining. Production of payable copper in 2002 was 2400 t, up from 1390 t in 2001.[166] Drilling during 2002 further defined the mineralization; this led to a feasibility study for an underground mine, which is scheduled to be completed in May 2003.[167] A new crusher has been purchased and the target installation date is mid-2003.[168]

LAC DES ILES MINE

	2001	2002
Millions of tonnes milled	2.66	4.85
Copper grade (%)	0.04	0.05
Contained copper (t)	1 420	2 400
Contained nickel (t)	724	1 250
Contained gold (kg)	299	499
Contained palladium (kg)	3 830	6 820
Contained platinum (kg)	313	597

Note: Data are rounded to three significant digits.

Northgate Exploration Limited owns 95% of Kemess Mines Ltd., which owns the Kemess South mine in British Columbia; Royal Oak Ventures, Inc. owns the remaining 5%.[169] Brascan Financial Corporation owns 36% of B.C. Pacific Capital Corporation, which in turn owns 41.59% of Northgate Exploration Limited.[170]

The equipment fleet in the 48 000-t/d open-pit gold-copper mine[171] includes two electric cable shovels, a loader and thirteen off-highway trucks;[172] the second cable shovel and the thirteenth haul truck were commissioned in 2002.[173] Kemess produced an annual record 33 000 t of copper and 8.78 t of gold in 2002, even with a lower average grade (0.236% copper and 0.724 g/t gold compared to 0.251% copper and 0.855 g/t gold in 2001) by milling 17.3 Mt in 2002 compared to 15.4 Mt in 2001.[174] As well, the increased recoveries obtained through the use of column flotation cells contributed to the higher output.[175] The mill was able to operate at 49 500 t/d for the second half of the year.[176] The copper concentrate produced at Kemess grades 20-25% copper with 50-150 g/t gold.[177] The three-year concentrate sales contract with Noranda Inc. ends on December 31, 2004.[178]

In June, a new three-year labour agreement was signed with 300 employees represented by the International Union of Operating Engineers, Local 115.[179] In 2002, Northgate was able to reduce the treatment and refining charges it paid by US7.5¢/lb, or US$165/t.[180]

During the year, exploration in the East and Central Cirque areas allowed an upgrade of resources from the inferred to indicated categories.[181] In 2002, 22 000 m of diamond drilling was completed.[182] Exploration work in 2003 at the Nugget Zone, located 1.3 km from the Kemess North pit outline, is targeted at locating a high-grade core in the inferred resources of 87 Mt grading 0.16% copper and 0.38 g/t gold.[183]

During the year, Northgate entered into a strategic alliance with Doublestar Resources Ltd. and Procon Mining and Tunnelling Ltd., who may develop the Sustut copper deposit located 65 km from the Kemess mine. The three companies undertook a feasibility study of the Sustut deposit, which has total resources of 5.9 Mt grading 1.87% copper and 6.11 g/t silver in the southeast zone; the feasibility study is due for completion in the first quarter of 2003.[184] The ore from Sustut would be milled at Northgate's Kemess operation.[185]

A new pit plan for Kemess South was completed during the year that reduced the stripping ratio from 1.2:1 to 1.05:1.[186] Northgate changed its tailings dam construction techniques, replacing non-acid-generating waste rock from the mine with a coarse de-pyritized fraction from the tailings. The savings on the 7-km haul distance and the reduction in the dam height resulted in a cost savings of over US$20 million over the life of Kemess South.[187] The new column flotation cells, which increased copper and gold recoveries, are projected to result in additional revenues of US$10 million yearly over the next six years.[188] Research work is expected to be completed that could allow, if successful, installation of a flash flotation process in the mill by the end of 2003; this would increase gold recovery by 2% by early removal of the gold from the milling before it is lost.[189] About two thirds of the revenue in the concentrates produced in 2002 was from the gold while the remaining one third was from copper; some silver is contained in the concentrates but no details were released in the company's annual report.

Production in 2003 was forecast by the company at 35 150 t of copper and 9144 kg of gold,[190] which, with a stripping ratio of 1.7:1, would result in the mining of 50 Mt of ore and waste.[191] Kemess South is expected to exhaust its reserves by the end of 2008[192] and the company is studying the Kemess North project (see below). The average production of Kemess South over the remaining mine life is projected at 9000 kg of gold and 34 000 t of copper.[193] The mine concentrate contains an unstated amount of minor by-product silver[194] for which the mine apparently receives credit.

Production from Kemess South in 2001 and 2002 was:[195]

KEMESS SOUTH MINE

	2001	2002
Millions of tonnes milled	15.40	17.30
Copper grade (%)	0.25	0.24
Copper recovery (%)	77	81
Contained copper (t)	30 100	33 100
Contained silver (t)	..	..
Contained gold (kg)	8 620	8 780

.. Not available.
Note: Data are rounded to three significant digits.

The Selbaie mine is owned 100% by BHP Billiton Plc through **Les Mines Selbaie.**[196] It is located approximately 400 km north of Montréal, Quebec, close to the border with Ontario. The proven ore reserves at mid-2002 amounted to 6.2 Mt grading 0.3% copper, 1.22% zinc, 22 g/t silver and 0.24 g/t gold, including stockpiled feed.[197] The mine's reserves at mid-year 2002 were 6.2 Mt, equivalent to 1.5 years at the 2002 milling rate,[198] namely until the end of 2003, assuming uninterrupted operations. The recovery of copper varied between 88.5% and 95.1% for the period July 2001 to June 2002, with zinc recovery at 73.5%, silver recovery at 63.5% and gold recovery at 65.6%.[199] Mine production in 2001 and 2002 was:[200]

SELBAIE MINE

	2001	2002
Millions of tonnes milled	3.83	4.08
Copper grade (%)	0.39	0.32
Copper in ore milled (%)	14 800	13 100
Copper recovery	–	–
Payable copper (t)	8 010	10 000
Payable zinc (t)	34 400	33 400
Payable silver (t)	51	68
Payable gold (kg)	865	597

– Nil.
Notes: Data are rounded to three significant digits. Copper grade and copper in ore are calculated.

CANADIAN PROJECTS AND MINES ON STANDBY IN 2002

Space and time preclude a review of all projects, mines on standby, and exploration programs in Canada. The selection of the following mines and projects does not imply that those discussed below are more or less advanced than others not included in this Copper chapter.

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Aur Resources Inc. completed the purchase of the **Duck Pond** copper-zinc deposit in Newfoundland and Labrador in March. Duck Pond is intended to replace Aur's output from its share of the Louvicourt mine, which is expected to close by mid-2005. Aur expects to decide in the first half of 2003 whether to proceed with the development of Duck Pond. The company has obtained all environmental permits and releases from the Province of Newfoundland and Labrador and expects to obtain a last release from Fisheries and Oceans Canada by mid-2003. Assuming a decision to proceed is made in mid-2003, Aur plans to incur capital expenditures of about $48 million in 2003 and 2004, and $6 million in 2005, in order to have the property in production by mid-2005. Aur expects to produce over a 10-year period about 16 000 t/y of copper contained in concentrates plus by-products of about 28 000 t/y of zinc, 18.7 t/y of silver and 110 kg/y of gold.[201] The mine is expected to start as an open pit but to move underground by the second year of operation.[202] Additional details about the Duck Pond deposit, contained in the December 6, 2001 press release, are available at www.sedar.com/csfsprod/data28/filings/00408518/00000001/m%3A%5CDec_07%5CToronto%5CAur12 06.pdf.

Breakwater Resources Ltd.'s **Langlois** mine spent 2002 on a care-and-maintenance basis. The mine was closed after problems in an ore pass in November 2000 and low zinc prices.[203] A feasibility study was completed in mid-2001 that recommended an increased cut-off grade and a mining rate of 450 000 t/y. A plan to mine 16 000 t of copper in concentrates from the mining of 2.9 Mt of ore over eight years was envisaged based upon a zinc price of US50¢/lb. (The LME cash settlement price for zinc averaged US$798/t, or US36.2¢/lb, for the month of December 2002.)[204]

A drilling program was started in the fourth quarter to better delineate reserves and to upgrade resources into reserves. Over 7900 m will be drilled at a cost of $650 000, of which the Quebec government will pay $255 000. After drilling is completed, a new feasibility study will be completed in the first half of 2003. A description of the mine and geology can be found in Breakwater's Preliminary Prospectus, February 18, 2002, pp. 64-77, available at www.sedar.com/csfsprod/data29/filings/00415187/00000003/C%3A%5CSEDAR%5CFILINGS%5CSR KTR2.pdf.

Campbell Resources Inc. is participating in the development of the **Copper Rand** mine in order to bring it into production in the second quarter of 2004. Campbell's subsidiary, MSV Resources Inc., owns 26% of Corporation Copper Rand Inc., which owns the Copper Rand mine and the Cedar Bay property.[205] Campbell has an option to increase its ownership to 50% of Copper Rand and has the right of first refusal on the remaining 50% of the company.[206] The Copper Rand mill has a capacity of 2700 t/d; after recovering gold by a gravity circuit, conventional flotation will be used to make a copper-gold concentrate.[207] The mine is being developed with the financial assistance of various Quebec-owned corporations.[208] The mine development, including deepening of the shaft to 1265 m, was completed by mid-year. A 1160-m decline is planned,[209] of which 240 m were excavated by year-end.[210] The overall cost of the mine development, including work on the hoist and mill, is estimated at $53.3 million.[211] Investissement Québec provided a loan facility of $22 million to CCR; this is guaranteed by a subsidiary of Campbell.[212]

Initial production is planned at a rate of 31 750 t per month of ore. This is to be increased to 40 800 t per month over the 4.75-year life of the mine.[213] The revised feasibility study of April 1999 noted reserves and resources equal to 2.4 Mt grading 1.70% copper and 3 g/t gold.[214] Commercial production is forecast to begin in April 2004 at an initial rate of 7260 t/y of copper and about 1550 kg/y of gold.[215] At 98.2% recovery for copper, the inventory noted would contain an estimated 40 000 t of recoverable copper; mined over the planned 4.75 years, annual production would average about 8400 t.

DRC Resources Corporation holds claims directly and under option at the site of the former copper producer, Afton Mines Ltd., which closed in 1988 after mining 27 Mt and producing 204 700 t of copper and 14 t of gold.[216] The property is close to a main paved highway, natural gas, electrical power and water. It is located about 10 km from Kamloops, British Columbia.[217] DRC received a report on its **Afton** copper-gold project in British Columbia in April 2002. This report recommended a $1.1 million drilling program at the deposit. In the December quarterly report, the company summarized the indicated mineral resources as:[218]

- Main Zone: 34 Mt grading 1.55% copper, 1.1 g/t gold, 0.125 g/t palladium and 3.42 g/t silver; and
- Northeast Zone: 1.1 Mt grading 1.02% copper, 0.86 g/t gold, 0.10 g/t palladium and 5.49 g/t silver.

Drilling in 2002 totaled 38 850 m.[219] In its December 2002 quarterly report, the company noted that it had engaged consultants to complete a prefeasibility study for the property.[220] The company has a deadline in late 2009 to bring the property into production at a minimum of 500 t/d of mill throughput or the mineral claims may revert to the optioners.[221]

Expatriate Resources Ltd. owns and participates in a number of copper properties in Canada. These include: the Ice deposit in the **Finlayson/Box** property and the Wolverine deposit in the Yukon, the Tillex property in Ontario, and the Yava deposit in Nunavut.[222]

The Wolverine JV properties are owned 60.6% by Expatriate and 39.4% by Atna Resources Ltd. The claims in the Finlayson Lake area were studied by AGRA Simons Ltd. in 2000, which was followed by metallurgical investigations. Expatriate understands that smelters prefer a blend of Wolverine and Kudz Ze Kayah ores as the Wolverine ores alone contain significant concentrations of selenium.[223] The Kudz Ze Kayah deposit was returned to Teck Cominco Limited after Expatriate failed to make a payment in 2001.[224] The combined reserves of Wolverine and Kudz Ze Kayah total 14.5 Mt grading 0.97% copper, 7.23% zinc, 1.53% lead, 184.5 g/t silver and 1.39 g/t gold. Of this amount, 11.1 Mt are from Kudz Ze Kayah and 3.5 Mt are from Wolverine. Wolverine by itself has a copper grade of 1.37% copper.[225] Expatriate plans to evaluate the joint development of its Logan zinc-silver pitable deposit in combination with the Wolverine deposit[226] in order to blend Wolverine's high-selenium ores to acceptable levels.

The Ice property in the Yukon has an indicated mineral resource of 4.6 Mt grading 1.48% copper, of which the company reported that 3.4 Mt were of near-surface mineralization.[227] The Yava property in Nunavut was acquired by Expatriate in 2001. A resource of 1.1 Mt grading 4.96% zinc, 1.03% copper, 1.60% lead, 117 g/t silver and 0.3 g/t gold was estimated in 1976 for Brascan Resources Limited. Infrastructure is needed to develop the property.[228]

Falconbridge expects to decide by mid-2003 whether to develop the **Montcalm** deposit, located near Timmins, Ontario. In the third quarter of 2000, Falconbridge signed a letter of intent with Outokumpu Mines Inc. for the right to earn a 50% interest by expending $24.5 million. At that time, the undiluted mineral resource was estimated to be 7.75 Mt grading 1.48% nickel and 0.7% copper, and production of 6000 t/y of nickel in concentrate was forecast.[229] In the June quarter of 2001, Falconbridge purchased the deposit for $14 million. At that time, the company estimated that the deposit, at 5 Mt, could sustain an output of 750 000 t/y of ore to produce 8000 t/y of nickel.[230]

Falconbridge has also had encouraging results with its exploration of the **Nickel Rim South** property in the Sudbury Basin. At the end of 2002, the inferred resource as defined by surface drilling was 6.3 Mt grading 3.4% copper with 1.7% nickel, 2.2 g/t platinum, 2.5 g/t palladium and 1.5 g/t gold.[231] Located at a depth of about 1600 m, the resource was outlined by a drilling program during 2001 and 2002. A decision is expected in 2003 whether to proceed with an underground exploration program.[232] Such a program would involve shaft sinking unless Falconbridge and Inco could come to an arrangement whereby the former could use the nearby Victor shaft; Victor was indefinitely deferred once the Voisey's Bay project was given the go-ahead in 2002.

Imperial Metals Corporation's **Mount Polley** mine remained on standby throughout 2002. Operations at the 100%-owned copper-gold open-pit mine/mill were suspended in September 2001 due to low metal prices. During 2002, ongoing research was directed at increasing copper recovery from copper oxide mineralization with the help of the federal government's Industrial Research Assistance Program. The company reported indications that the recovery rate could be boosted from 11% for the highly oxided material from the Springer pit using conventional flotation up to 78% using a leaching technique. This would have the effect of increasing the planned output from the Springer pit from 54 400 t/y to about 81 600 t/y of copper[233] once the Mount Polley mine were to restart. The Springer pit area has been logged and the access roads have been completed.[234]

The Springer pit would be the major source of feed when the mine re-opens. Probable ore reserves at Mount Polley as of September 30, 2001 (and currently), totaled 31.9 Mt grading 0.356% copper and 0.337 g/t gold, with a 17.5% oxide ratio, distributed as:[235]

Pit	Tonnes	Cu Grade	Oxide Ratio	Gold
		(%)	(%)	(g/t)
Cariboo	52 700	0.298	10.2	0.505
Bell	5 515 700	0.311	2.9	0.338
Springer	26 341 000	0.366	20.6	0.366

Note: Tonnes are rounded to nearest 100 tonnes.

Additional work on the copper oxide leaching is planned for 2003; depending upon the results of the column testing, the ore reserves could be re-evaluated to take the higher recovery from the oxide ores into account. In addition to this work, more exploration is planned for 2003. The Springer pit has not yet been fully defined at depth.[236]

Inco reached agreement with various parties and announced that it would proceed with the development of **Voisey's Bay** (see below for details of agreements). Preparatory development of infrastructure began during the year, both at Voisey's Bay and at Argentia, the future site of a pilot plant for a new hydrometallurgical process being developed by Inco to process the nickel-cobalt concentrate from Voisey's Bay. Copper concentrate will be separately produced from the nickel-cobalt concentrate at the mill. The copper concentrate will be sold, rather than processed at Inco's smelters, which face emission limits for sulphur dioxide. In later years when the hydrometallurgical plant is assumed to be operational, the projected annual production rate of copper will be 31 750 t of copper in copper concentrate and about 6800 t of copper contained in nickel concentrates.[237]

Initially, the nickel-cobalt concentrate will be sent to Inco's facilities in Ontario and Manitoba for processing. Following development of the hydrometallurgical process, the Province and the company expect that a commercial hydrometallurgical plant will be constructed at Argentia to process the Voisey's Bay nickel-copper output.[238]

Inco and the Province of Newfoundland and Labrador agreed upon the principles for the development of the Voisey's Bay nickel deposit, located on the coast of Labrador, in June 2002. In May 2002, Inco's subsidiary, Voisey's Bay Nickel Company Limited (VBNC), had reached separate agreements with two Aboriginal groups; the agreements were ratified by the two Aboriginal groups in July 2002. In October, the Province and VBNC released their definitive agreements, dated September 30, 2002, to implement development of the project. Complete details of the Voisey's Bay Employment and Industrial Benefits Agreement and the Voisey's Bay Development Agreement are available (14-Mb file) at www.sedar.com/csfsprod/data33/filings/00485302/00000001/e%3A%5CINCO%5C2002%5C8Koct8.pdf.

Information from the provincial government is available through links located at www.gov.nf.ca/voiseys.

As a consequence of the completion of the arrangements required to develop Voisey's Bay, Inco was able to evaluate the carrying value of the project. This resulted in a large write-down of the carrying value of the asset.

Briefly, the agreements include:[1]

- Initial work worth at least $35 million at the mine site and at Argentia to be undertaken by March 31, 2003.
- A $130 million R&D program, including a pilot plant at Argentia to be completed by December 31, 2006, with no nickel concentrate shipments from the province to occur before completion of the pilot plant or before shipments of concentrate to the pilot plant.
- A $170 million mine, concentrator and infrastructure to be built during 2003-2006 capable of producing 6000 t/d of ore into nickel and copper concentrates providing 400 jobs; production to be limited to 2.2 Mt/y of ore for the first 10 years of mine production and to 5.5 Mt/y of ore thereafter.
- Copper concentrate may be shipped outside the province unless sufficient quantities are discovered to warrant processing facilities or the construction of a processing facility by a third party.
- Nickel concentrate may be shipped outside the province after completion of a pilot plant at Argentia until the earlier of: a total of 355 000 t of contained nickel in concentrates shipped, or completion of the hydrometallurgical plant, or there is no decision about a hydrometallurgical plant by November 15, 2008; after completion of the hydrometallurgical plant, up to a further 85 000 t of contained nickel in concentrates may be shipped out of the province until the commercial production date of the hydrometallurgical plant (defined as an annualized production rate of 30 000 t/y of a nickel product containing at least 99.8% nickel for a period of 90 days).
- Before mining ceases, shipment of nickel in intermediates to commence at a rate yielding not less than 25 000 t/y of finished nickel products (at least 99.8% nickel content) and must continue until the total tonnage of nickel plus cobalt shipped into the province is equal to the total tonnage of nickel plus cobalt contained in concentrates shipped out of the province.
- A $20 million advanced surface exploration program to be conducted between 2002 and 2006 as part of a $95 million exploration program designed to define sufficient reserves to permit expansion of the mine and concentrator.
- A $750 million expansion of the concentrator and construction of an underground mine providing 800 jobs designed to keep the hydrometallurgical plant operating at full capacity.
- The decision about the processing plant (hydrometallurgical plant or the matte processing plant) is to be made by November 15, 2008, with plans delivered to the government by December 31, 2008, so that the plant is built by December 31, 2011. The $800 million hydrometallurgical plant, built over three years, is to produce approximately 50 000 t/y of nickel products of at least 99.8% nickel and provide 400 jobs; a matte processing plant would be built if the hydrometallurgical plant is technically unfeasible such that the matte plant would produce approximately 50 000 t/y of nickel products grading at least 99.8% nickel.
- The Province granted the mining lease to Voisey's Bay on September 30, 2002, subject to various conditions.

Inco's Annual Report for 2002 described the federal government's involvement in the region as:

> "the Government of Canada is making available up to C$150 million from its existing programs to support activities in and around the Voisey's Bay project as they relate to innovation, training and business development opportunities for Aboriginal people."

A government press release and details about the relevant programs of four government departments can be found on the Internet at www.acoa-apeca.gc.ca/e/media/press/press.shtml?1813.

Inmet owns 100% of the **Izok Lake** zinc-copper property in Nunavut. Izok's indicated resources are 16.5 Mt grading 2.2% copper, 11.4% zinc and 60 g/t silver.[239] A feasibility study of the project was completed in 1994.[240] The project requires infrastructure in order for the concentrates to be shipped to markets. The Bathurst Inlet Port and Road (BIPR) project, estimated to cost about $215 million, envisaged a 210-km all-weather road connecting a port on Bathurst Inlet with the eastern shore of Contwoyto Lake; an 80-km road would then proceed from the other shore of Contwoyto Lake to the Izok Lake project site, with the two road sections being connected by an ice road in the winter and barges in the summer. The BIPR would require environmental approval before proceeding. The proponents, who include the Kitikmeot Corporation, an Inuit company, favour an environmental review by the Nunavut Impact Review Board, a public government body. The opponents favour a more detailed review that would include funding for interveners. The Minister of Indian and Northern Affairs Canada is to decide the nature of the review, requested in July 2002. In December, the proponents informed regulators that the 80-km road to Izok Lake would be dropped from the plans because Izok Lake would not be developed at current low zinc prices.[241]

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[1] The reader should refer to the web reference for the actual wording of the agreement in its entirety, including the definitions of specific terms for purposes of the agreement; the information listed above is not all inclusive and does not necessarily use the language and terms of the agreement. It is intended only to provide general information.

Minto Exploration Ltd. holds 100% of the **Minto** project, located about 250 km northwest of Whitehorse, Yukon, on the west side of the Yukon River. The deposit consists of in-situ geologic reserves of 8.8 Mt grading 1.73% copper, 0.48 g/t gold and 7.5 g/t silver. The mining plan calls for open pitting of 6.5 Mt grading 2.13% copper, 0.62 g/t gold and 9.3 g/t silver over an initial life of 11 years. The mine is intended to produce an average of 13 400 t/y of copper plus 5.35 t/y of silver and nearly 360 kg/y of gold contained in 35 000 t/y of concentrates. As of 1999, the capital cost was estimated at $27.3 million, including working capital.[242]

Minto is owned by ASARCO Incorporated. In 1996, Minto and ASARCO agreed to advance the Minto project; ASARCO agreed to spend up to US$25 million to develop the property in return for a 70% share in the venture. As of year-end 2002, ASARCO had spent US$8.5 million to support the project, which had been suspended in March 1988.[243]

Noranda Inc.'s **Perseverance** property is located very close to Noranda's Bell-Allard mine near Matagami, Quebec. A feasibility study of the Perseverance property has been completed. Noranda owns a 90% interest and Société de développement de la Baie James owns the remaining 10%.[244] In December 2002, Noranda announced that, because of low zinc prices, it would delay the development of the nearby Perseverance zinc deposit. That deposit consists of three high-grade zinc zones: Perserverance, Equinox and Perseverance West, which also contain an average of 1.24% copper. The delay will mean a minimum 15-month interval between the closure of the Bell-Allard mine in the fourth quarter of 2004 and the possible start-up of the Perseverance operation.[245]

Northgate Exploration Limited targeted mid-2003 for completion and release of its prefeasibility study of the **Kemess North** project begun in December 2002. Kemess North is intended to replace production from Kemess South, which is expected to exhaust its reserves by the end of 2008. A feasibility study of the project is expected to begin in mid-2003, subject to board approval. Alternate methods of transporting the ore from Kemess North to the existing concentrator are being studied, including a 5-km tunnel for a conveyor. Some of the cost savings are being investigated in the studies, including higher ore throughput and lower-cost tailings disposal. Because the Kemess North ore is not as hard, the Kemess South mill is expected to be able to handle 75 000 t/d. Also, some tailings from the Kemess North mine may be deposited in the former Kemess South pit. At the end of 2002, the capital cost estimate for the Kemess North project was US$150 million, equally divided between pre-stripping costs and the ore transport infrastructure. A start-up date of 2009 was shown in the company's 2002 Annual Report. Northgate is investigating scheduling the pre-stripping during 2006 when the waste-to-ore ratio drops significantly at Kemess South[246] (e.g., the stripping ratio is expected to be 1.7:1 in 2003, but only averages 1.05:1 over the period 2003-08). During 2003, Northgate plans to upgrade the resources at Kemess North to reserve status.[247]

The **Sudbury Basin Joint Venture** (SBJV) is owned 75% by FNX Mining Company Inc. and 25% by Dynatec Corporation.[248] (FNX was known as Fort Knox Gold Resources Inc. until June 20, 2002.)[249] FNX manages the exploration and Dynatec will manage mine development and operation.[250] The SBJV reached an agreement with Inco in January 2002 to purchase five properties from Inco, subject to certain conditions. For example, if a new deposit is discovered with more than 272 000 t of contained nickel, Inco has a right to reacquire a 51% interest in the property. Inco and the SBJV have an off-take agreement for production from the properties, subject to various conditions.[251] A synopsis of the agreement with Inco is available on the Internet at www.fnxmining.com/fnx/inco291201.pdf.

The joint venture began a $14 million work program over 16 months, including drilling, development work, and various engineering and geological studies. The initial $14 million program was within the context of a total expenditure of $30 million over 52 months.[252] The properties involved are the McCreedy West mine, the Levack mine, the Victoria mine, the Kirkwood mine and the Norman North platinum group metals-copper-nickel mineralized zone.[253] The SBJV completed 108 000 m of exploration drilling in nine months in 2002.[254]

Future production from these locations would be sent to Inco for milling, smelting and refining, subject to available capacity at Inco facilities. In its 2002 Annual Report, Dynatec stated that the $14 million work program had been completed ahead of schedule and that the partners expected to spend the required $30 million by the end of 2003, two years ahead of the deadline.[255] Dynatec also stated that initial production was expected from the McCreedy West mine in the June quarter of 2003.[256] The SBJV's exploration budget in 2003 is $24.5 million.[257] Resource estimates for some of the properties contained in the FNX Mining Company Inc. annual information form and annual report for 2002 are shown in Tables 1 and 2 (i.e., the mineral resources tables, page A-37) of the document found at www.sedar.com/csfsprod/data38/filings/00542790/00000001/g%3A%5CSedar%5CFNXMin%5CAIF20 03%5CAIFDec312002.pdf.

Appendix A of the 2002 annual information form for FNX Mining Company Inc. shows historical production and provides descriptions of the former Inco properties under consideration; this report can be found on the SEDAR site at the location noted immediately above.

Redcorp Ventures Ltd.'s subsidiary, Redfern Resources Ltd., owns the **Tulsequah** project in northwestern British Columbia,[258] located 100 km from Atlin, British

Columbia, and 65 km northeast of Juneau, Alaska. The claims are located adjacent to the Canada-U.S. boundary.[259] In British Columbia, a Project Approval Certificate (PAC) was required in order to proceed with construction of the mine. Originally, the company had received its PAC in March 1998 after a three-year environmental assessment review. The PAC was challenged by the Taku River Tlingit First Nation and the B.C. Supreme Court quashed the PAC. Redfern appealed and the B.C. Court of Appeal upheld the appeal and, in January 2002, remitted the project back to the B.C. ministers for a new decision about the PAC. In December 2002, Redfern again received its PAC allowing the company to proceed with the project.[260] Cominco Ltd. operated two mines at the site from 1951 to 1957, producing just over 900 000 t of ore.[261]

Redfern announced that it intended to proceed with a drilling program to further define the current resource. Concurrently the company will seek financing, including potential partners, for development of the project.[262] An existing reserve estimate shows 7.6 Mt grading 6.63% zinc, 1.31% copper, 1.24% lead, 105 g/t silver and 2.5 g/t gold.[263] A feasibility study was completed predicated on a 2500-t/d mill, taking 900 000 t/y of ore feed[264] from an underground mine, using conventional flotation techniques to produce a lead concentrate, a zinc concentrate, and a copper concentrate. A gold concentrate will be produced by gravity means. The copper concentrate would contain an estimated 10% lead by weight.[265] The estimated payable outputs from the operation (contained metal contents should be higher) were: 10 400 t/y of copper, 52 600 t/y of zinc, 4990 t/y of lead, 75.3 t/y of silver, and 1.84 t/y of gold.[266] Capital costs were estimated at $148 million,[267] but these are to be updated in a revised feasibility study that will also take into account drilling to be done in 2003. The company will complete some additional environmental work required by Fisheries and Oceans Canada.[268]

In 2002, Getty Copper Corporation (name changed to Getty Copper Inc. in January 2003) continued exploration at its **Getty North** and associated properties in the Highland Valley, British Columbia, near the Highland Valley mine owned by Teck Cominco Limited and BHP Billiton Plc (see above). Getty commissioned a study of the properties, and a technical review, done in December 2002 and modified in February 2003, was released.[269] The report stated that only the Getty North deposit had sufficient exploration to allow a resource estimate.[270] Using a cut-off grade of 0.1% copper, the indicated oxide resource was 6.8 Mt grading 0.522% copper and the sulphide zone drill-indicated resource was 27.6 Mt grading 0.410% copper.[271] In April, Getty announced that it had commissioned a scoping study by Innovat Limited of continuous vat leaching, producing possible alternative forms of copper, including copper sulphate crystals, as an alternative to SX/EW (solvent extraction and electrowinning) heap leach.[272]

Gibraltar Mines Limited is owned 100% by Taseko Mines Limited. Gibraltar was bought from Boliden Westmin (Canada) Limited in 1999.[273] Gibraltar is located 65 km from the town of Williams Lake, British Columbia. The open-pit operation ran from 1972 to 1998, when it was closed due to low prices and placed on care and maintenance.

In 2001, Gibraltar Mines Limited, Gibraltar Engineering Services Limited Partnership (GESL), and Cominco Engineering Services Ltd. (CESL) concluded a memorandum of understanding to jointly evaluate the potential for a hydrometallurgical copper refinery at the **Gibraltar** mine.[274] In addition to sulphide copper mineralization, there are in-pit oxide zones that would be processed by SX/EW.[275] Gibraltar supplemented its conventional flotation process with the leaching of low-grade ore and electrowinning of the leachate produced. A total of 38 430 t of electrowon copper was produced from October 1986 until the SX/EW plant was shut down.[276]

A scoping study completed in August 2000 projected capital costs of $95 million for a copper refinery and $25 million to restart the mine, which included costs to modify the concentrator and to complete six months of preproduction stripping at the Pollyanna pit. That study showed an internal rate of return of 18.4% and "no apparent fatal flaws."[277] In 2001, Bateman Engineering Pty of Australia was engaged to undertake an "engineering feasibility-level cost study for the construction and operation of a hydrometallurgical copper refinery utilizing CESL technology at the Gibraltar mine." A capital cost of $109.5 million and an operating cost of US14.7¢/lb were estimated for a refinery producing 30 000 t/y of LME-grade copper from 130 000 t/y of copper concentrates grading 24% copper.[278] Further work was ongoing through 2002 funded by GESL and CESL on a 50:50 basis. Most of the work examining the feasibility of building a copper refinery at Gibraltar using the CESL-developed process was completed by mid-2002; however, a decision to proceed is dependent upon higher copper prices and other factors.[279]

Total sulphide resources are 743 Mt grading 0.287% copper and 0.008% molybdenum at a cut-off grade of 0.2% copper. In addition, there are 16.4 Mt grading 0.2% copper of oxide and leachable copper resources.[280] In-pit sulphide measured and indicated resources amount to 208 Mt grading 0.311% copper and 0.010% molybdenum, which are located in the Pollyanna zone, the Connector zone and the Granite Lake zone.[281] In-pit leachable copper measured plus indicated "inventory" amount to 18.1 Mt grading 0.146% copper and 0.10% molybdenum located in the Pollyanna pit and the PGE Connector pit.[282]

During 2002, Gibraltar and the Cariboo Regional District of south-central British Columbia agreed to the construction and operation of an 80-year landfill utilizing waste rock areas not required for future mining operations; Gibraltar will construct, operate and maintain the landfill on a fee-for-service basis. The landfill construction will begin in mid-2003 and operations will commence in October 2003.[283]

Taseko's **Prosperity** project is located about 200 km from Williams Lake, British Columbia. After a number of studies, Taseko decided in 2002 to study in more detail an option of mining at a rate of 70 000 t/d based upon 491 Mt grading 0.22% copper and 0.43 g/t gold. Further work showed a 16-year mine life producing 188 885 t/y (dry) concentrate grading 24.5% copper, 38.8 g/t gold and 89 g/t silver that would be trucked to Vancouver, British Columbia, and then shipped to overseas smelters. Thus, annual production would be about 46 300 t of copper with by-product production of 7.3 t of gold and 16.8 t of silver. Taseko decided to focus its attention on the Gibraltar project, and the level of activity on the Prosperity project declined accordingly after 2000.[284]

USE OF COPPER IN CANADA

Canadian copper use is not surveyed on an annual basis. Apparent use can be calculated by adding the imports of refined copper to the reported domestic shipments of copper producers. For 2002, as noted earlier, these data were: 11 600 t of refined imports plus 257 100 t of producers' domestic shipments (8000 t and 257 200 t respectively in 2001). A recent survey was instituted to measure the recycling of copper in Canadian copper and copper alloy facilities.

Various sources of information exist on the Internet for those wishing to find additional information about copper use in Canada; these web sources are detailed in subsequent paragraphs.

The **Canadian Copper & Brass Development Association** (CCBDA) assists copper and copper alloy users on many matters, including technical information. Its web site contains technical information that can be ordered online for such topics as alloy castings, tubing, forgings, etc. Technical assistance and library services are also available. The membership consists of both users and producers of copper. Companies making wire, tubes, rod, plumbing fixtures, castings and forgings are among those that are members of the CCBDA. The association's web site can be found at www.ccbda.org.

The CCBDA web site also provides links to other copper development associations. There is information:

- in French at www.cuivre.org and at www.copperbenelux.org; and
- in English at www.copper.org (United States), www.copperinfo.com (international), www.copper.org.sg (South-East Asia), www.procobreperu.org/home.htm (Peru), www.indiancopper.org (India), and www.jcda.or.jp (Japan).

Information is also available in other languages, including Finnish, Danish, Dutch, German, Greek, Italian, Japanese Norwegian, Portuguese, Spanish and Swedish through links shown at www.copperinfo.com/professionals/index.shtml#CRIF.

The **Canadian Association of Recycling Industries** is the national organization of recycling industries, of which metal recycling, and copper recycling in particular, is an important component. The Association represents companies through the entire chain of recycling from scrap collection to processing and utilization (www.cari-acir.org).

The **Canadian Foundry Association** (CFA) is the national association of foundries in Canada, formed in 1975. Its members include brass and bronze foundries. Its site contains a membership list with links to the members' web sites (click on "Member Profiles"). The CFA web site is located at www.foundryassociation.ca.

The **Canadian Die Casters Association** represents companies in Canada engaged in pressure die casting. Its site contains information about members and links to web sites (click on "Member Profiles" in left frame). Companies seem to publicize their use of aluminum, zinc and magnesium rather than that of copper. The CDCA web site is located at www.diecasters.ca.

Industry Canada maintains a web site that allows searches for companies engaged in semi-fabrication of metals and fabrication metals, including copper and copper alloys. The Canadian Company Capabilities (CCC) data base can be searched using terms such as "copper," "brass" or "bronze." The site is located at http://strategis.ic.gc.ca/cgi-bin/allsites/search/basic/viewhits?lang=e&file=R317907.

A search of companies having in their product/service description the words "brass," "bronze" or "copper" showed the following number of "hits":

• brass:	249 companies
• bronze:	126 companies
• copper:	306 companies

The CCC search narrowed to "Primary Metal Manufacturing" is located at http://strategis.ic.gc.ca/SSG/mm01798e.html.

Industry Canada has compiled information about Canadian metal casters; the reporting culminated in interviews with companies in early 2000. A report about metal casting can be accessed on the Internet at http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/vwapj/Metalcasting_TRM.pdf/$FILE/Metalcasting_TRM.pdf. The reader can go to Appendix A of this report to view the names and the metals handled by Canadian casters. In an earlier web page, searching and sorting by criteria was possible. Using that capability, the data showed that 72 of the 239 casters reported some capability with copper casting. These copper users were distributed as:

Province	Number
Ontario	36
British Columbia	17
Alberta	8
Nova Scotia	6
Manitoba	2
Quebec	2
Prince Edward Island	1
Total	72

By clicking on the links to Appendix A at the bottom of the web page noted immediately above, the reader may view companies by geographic groupings showing company name and location.

WORLD COPPER REVIEW

Space and time do not permit a review of events in the world copper industry. A brief outlook is prepared by the Minerals and Metals Sector of Natural Resources Canada each year and the latest one done, dated November 2002, is available on the Internet at www.nrcan.gc.ca/mms/pdf/nfo/nfo02/copp-e.pdf.

Bloomsbury Minerals Economics Ltd (www.bloomsburyminerals.com/BME.htm) has written a succinct analysis of how the present copper market evolved. With permission from Bloomsbury, it is reproduced here (the views expressed in this analysis are entirely those of Bloomsbury):

> "In the late 1980s, there was an unexpected change in the trend growth rate of copper consumption. It accelerated suddenly, by 1.5% per annum, from under 2% per annum to a new rate of over 3%. Copper producers were initially very cautious in accepting this as anything more than a short-term phenomenon. However, the new trend did endure and, as a result, the period from mid-1987 to mid-1996 showed a tendency towards shortages of copper (occasionally exacerbated by market manipulation) and high prices. High prices benefited miners directly, but smelters and refiners also flourished. High long-term contract charges for custom smelting and refining were made possible by both the buoyant price environment and the discipline and dominance of two major buying blocs: Japan for custom concentrates and western Europe for blister.
>
> "Encouraged by what seemed like an endless boom both in volume and prices, mines invested in new capacity that, from 1996, totally overwhelmed the market. Meanwhile, smelting and refining capacity grew dramatically outside the traditional custom processing centres of Japan and western Europe. With the down-side apparently limited by the strong discipline shown by the established major blocs, and with volume growth looking assured, new smelters and refineries were built in India and China and major expansions were launched in South Korea and Mexico. Competition intensified and, over a period from mid-1996 to mid-1999, first prices for refined copper, and then custom processing margins on copper concentrates and blister, collapsed.
>
> "By the third quarter of 1999, exchange stocks had risen to very high levels and over 750 000 tonnes per year (t/y) of mine capacity had been shut down, some of it permanently, but most kept on care-and maintenance. A similar amount of smelter capacity was shut down, as was over 500 000 t/y of refining capacity. These cutbacks and closures returned the refined copper market to balance in late 1999 and then led to a large deficit in 2000. Although it was clear that trend consumption had increased further in the late 1990s (to almost 4% p.a.) and even though a boom in the copper-intensive high-tech sector also benefited copper, exchange stocks that had been built up over 1997-99 still overhung the market to some extent and prices rose only modestly in 2000. Then, in 2001, copper suffered along with other metals from a severe downturn in demand in high-tech sectors as well as old-economy industries, which drove the market back into surplus."

To put copper in context, it is the third-ranking metal produced and used in the world, behind aluminum and steel. Total copper production in 2002 was reported at 15.3 Mt, of which about 12%, or 1.9 Mt, was produced from recycled sources (see also World Copper Data on page 1 of this chapter).[285] In comparison, the world crude steel production in 2002 was over 900 Mt,[286] derived from primary and recycled feed materials. Aluminum is the second most produced metal with primary refined production reported by the International Aluminium Institute (IAI) at over 21.2 Mt in 2002[287] with an estimated further 2.2 Mt produced from purchased or tolled scrap.[288] However, not all countries report to the IAI. NRCan's aluminum specialist estimates that world primary plus secondary production in 2002 was in the order of 34 Mt, of which about 26 Mt was primary production (see the Aluminum chapter in the 2002 *Canadian Minerals Yearbook*).

The relative quantities of the world production of major metals in 2002 are presented below:

Metal	Million Tonnes
Steel	900
Aluminum	26
Copper	15
Zinc	10
Lead	6
Nickel	1

Sources: IISI, IAI, ICSG, ILZSG, INSG.

APPLICATIONS

Copper is used in many applications. Due to its high electrical conductivity, a prime application of copper is wire and cable used to carry power and signals. The high conductivity means good efficiency, and good corrosion resistance means that copper is a very good electrical conductor. High conductivity means a smaller cross-section for wires relative to other metals, which is important for small motors, hand tools, and crowded conduit spaces. However, in long-distance transmission lines, the heavier density of copper relative to conductivity means that aluminum is preferred to copper as the current-carrying metal for such lines.

Copper also has a high thermal conductivity that makes it a leading competitor for heat exchangers such as automotive radiators and for solar heating. More information about the applications of copper can be found on the web site of various copper development organizations. An extensive review of applications is available at www.copperinfo.com/cproducts/index.shtml.

The **International Copper Study Group** (ICSG) based in Lisbon sells detailed statistics on world copper production, use and trade. Details are available on its web site at www.icsg.org.

The United States Geological Survey (USGS) is another source of detailed information about the world copper industry. The copper information available includes yearly reviews, monthly articles, and an annual summary. The copper portal for the USGS is located at http://minerals.usgs.gov/minerals/pubs/commodity/copper.

Copper use is generally measured at the semi-fabrication stage. If copper products are made into wires, tubes, etc., that are principally copper and copper alloys, these imports and exports can be tracked. But once incorporated into fabricated items such as electronics, ships, aerospace goods, transformers, motors, etc., then it is difficult to track the ultimate destination of copper. Imagine a customs broker being asked to declare the copper content of imported motor vehicles or of imported CD players. Therefore, a calculation showing the "consumption per capita" ignores the ultimate user/consumer of the metals in question by focusing on the available data collected at the semi-fabrication stage.

For example, using statistics of the ICSG, which show that the Danish use of copper was only 100 t in 2002, one might presume that the Danish society is relatively copper-free. Danish copper usage since 1998 shows that total usage for 1998 to 2002 in those five years amounted to 500 t.[289] One could calculate the average per capita Danish copper use as just over 50 mg of copper daily (population of 5.37 million[290]). This is equivalent to a monthly usage of less than the copper content of an old-style single Canadian penny (the penny was a 2.5-g coin, of which 98% by weight was copper, during the period 1982-96.)[291]

However, the Danes have modern enterprises and accommodations with electrical wiring, copper tubing, electric motors, etc. Danes import and use copper in automotive vehicles, aircraft, ships, electronics, and electrical goods such as household appliances, electrical generators, all types of electrical motors, and refrigeration and air conditioning units, which are not counted in the calculated "use" of copper in Denmark.

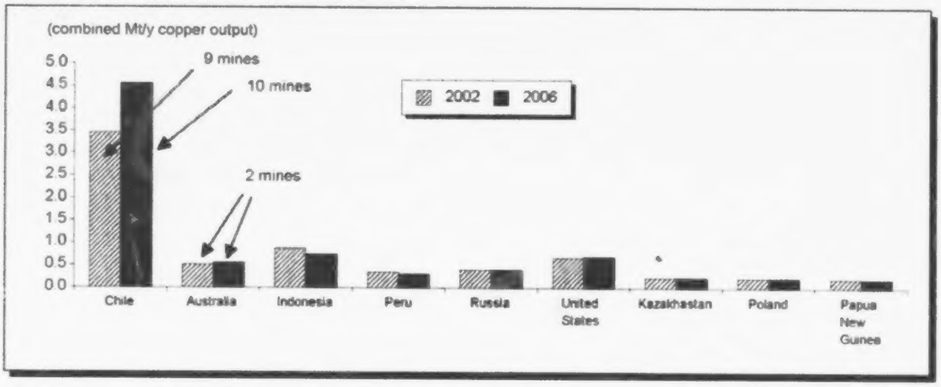
Thus, calculations of copper usage or copper "consumption" for individual countries or groups of countries may be misleading. A better but less specific figure is the calculated world copper usage, which was about 2.4 kg per capita in 2002.[292]

PRODUCTION

The ICSG and USGS web sites noted above are sources of information about world production of copper. In addition to these sources, major international copper-producing companies in the world have web sites with detailed production and financial information. The corporate sites also contain descriptions of operations. Web sites for some major producers are shown in Table 5 so that the reader can obtain more information. Refer to Table 3 for a list of Canadian companies involved with copper production or development.

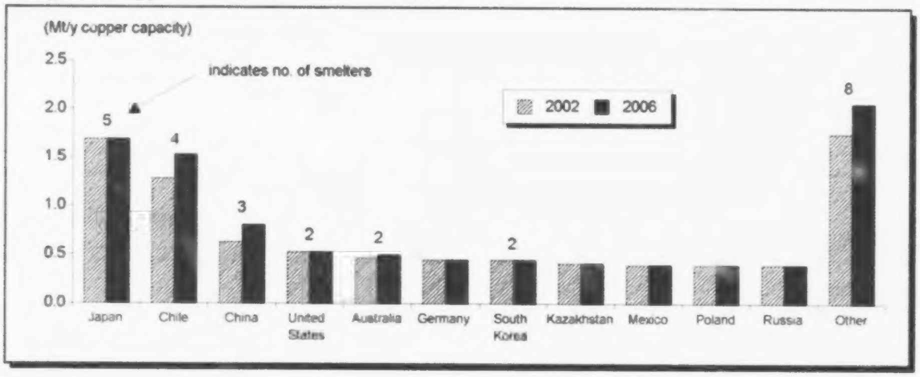
All else being equal, large production facilities have a cost advantage over smaller facilities. Economies of scale allow large plants to remain competitive in times of low

Figure 8
Large (1) Copper Mines in 2002 and 2006



Source: International Copper Study Group, *Directory of Copper Mines and Plants*.
(1) There are 19 mines with a capacity of at least 200 000 t/y of copper in concentrate in 2002.
Note: One mine for all countries unless indicated otherwise.

Figure 9
Large (1) Copper Smelters in 2002 and 2006



Source: International Copper Study Group, *Directory of Copper Mines and Plants*, April 2003.
(1) There are 31 smelters with a capacity of at least 200 000 t/y in 2002.
Notes: "Other" = 8 smelters in 7 countries (Spain, India, Peru, Sweden, Indonesia, Zambia and Bulgaria). One smelter for each country unless indicated otherwise.

prices. The high proportion of production from "large facilities" is illustrated in the following sections about "mining," "smelting" and "refining."

Mining

In 2002, 19 facilities in 9 countries had capacities of at least 200 000 t/y of copper in concentrates (including SXEW production).[m] Together these facilities accounted for 46% of world mine capacity (see Figure 8). Chile had 9 operations in the top 19 in 2002 and is projected to have 10 by 2006. Only Australia and the United States have two such facilities; all remaining countries have only a single producer of major rank.

Smelting

In 2002, 25 facilities in 15 countries had capacities of at least 200 000 t/y of copper in anodes (see Figure 9).

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[m] SXEW = solvent extraction and electowinning. This method is not currently employed in Canada but is being studied by Taseko Mines, amongst others. The ore from the mine is exposed to an acidic carrier such that the copper is dissolved. The copper is recovered in an electrowinning process, somewhat akin to a refining process. SXEW skips the smelting stage. Phelps Dodge Corporation is to commence testing hydrometallurgy to process chalcopyrite in 2003; SXEW operations typically use copper oxide ore as feed material.

Together these facilities accounted for 53% of world smelter capacity in 2002. The copper-using countries dominated the large smelter industry. Japan had five facilities with a total capacity of nearly 1.7 Mt/y. Chile, a copper producer, was second with nearly 1.3 Mt/y; however, China and the United States were third and fourth with large facilities having combined capacities of 630 000 t/y and 530 000 t/y, respectively. Only six countries had more than one large smelting facility (capacity of at least 200 000 t/y).

A list of world copper smelters in 2002 is available from the USGS at http://pubs.usgs.gov/of/2003/of03-075/CSTable.html.

Refining

In 2002, 29 facilities in 11 countries had refineries with capacities of at least 200 000 t/y (see Figure 10). These refineries accounted for 49% of world refinery capacity in 2002. The refinery capacities also include electrowinning production capacity. Chile has a combined electrorefining and electrowinning capacity of 1.8 Mt/y. Japan was second with an electrorefining capacity of 1.25 Mt/y while the United States was third with a combined large electro-refining and electrowinning facility total of 1.1 Mt/y. Only six countries had more than one large facility with a capacity of at least 200 000 t/y.

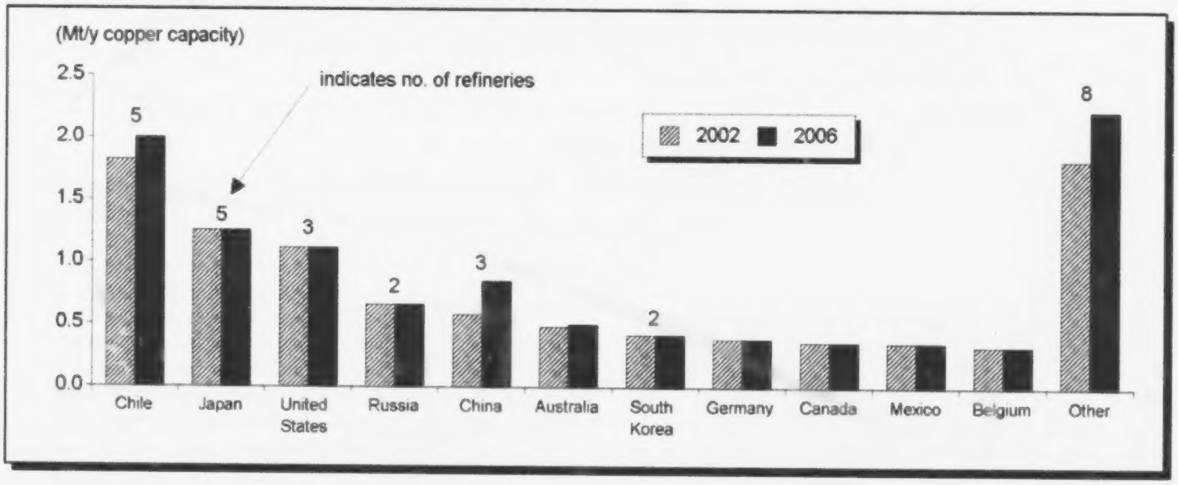
PRICES

As noted on page 1 of this chapter, the London Metal Exchange (LME) settlement price for copper averaged US$1577/t for Grade A copper in 2002. Copper inventories on the LME increased from just under 800 000 t at the end of 2001 to over 855 000 t at the end of 2002. Total copper stocks, or the sum of the exchange stocks of the LME, the COMEX[n] and Shanghai, increased from a total of over 1.135 Mt at the end of 2001 to over 1.29 Mt at the end of 2002.[293]

Figure 11 shows LME cash settlement copper prices and a running 90-day historical average for 2001 and 2002. Figure 12 shows the same price series for the period 1989 to 2002, which puts the lower prices since late 1997 into a historical context.

The price graphs show prices in current prices, not adjusted for inflation. Inflation has very little to do with determining copper prices, which are more related to the

Figure 10
Large (1) Copper Refineries in 2002 and 2006



Source: International Copper Study Group.
(1) There are 33 refineries with a capacity of at least 200 000 t/y in 2002.
Notes: "Other" = 8 refineries in 8 countries (Peru, Spain, Zambia, Sweden, Brazil, Indonesia, Iran and India). One refinery for each country unless indicated otherwise.

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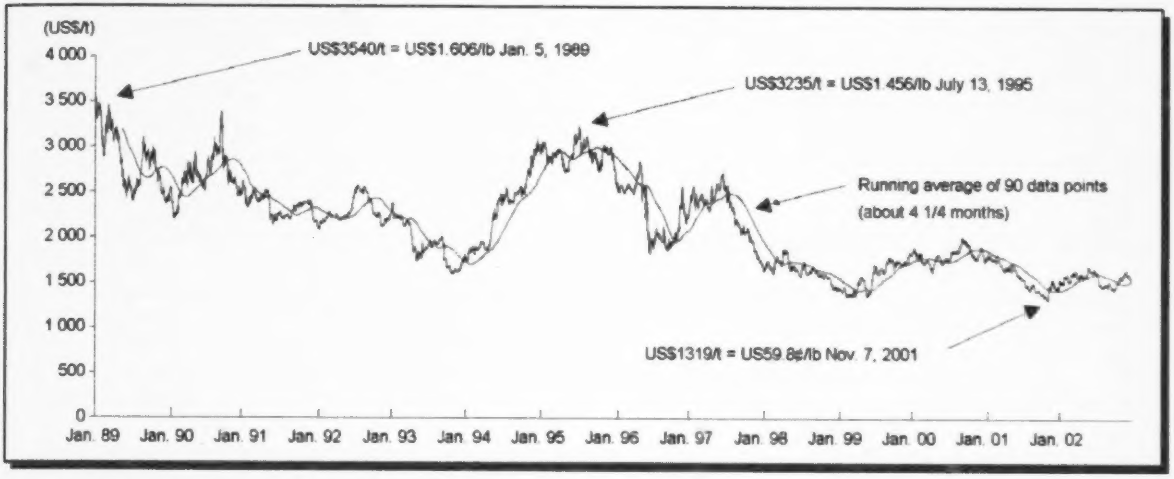
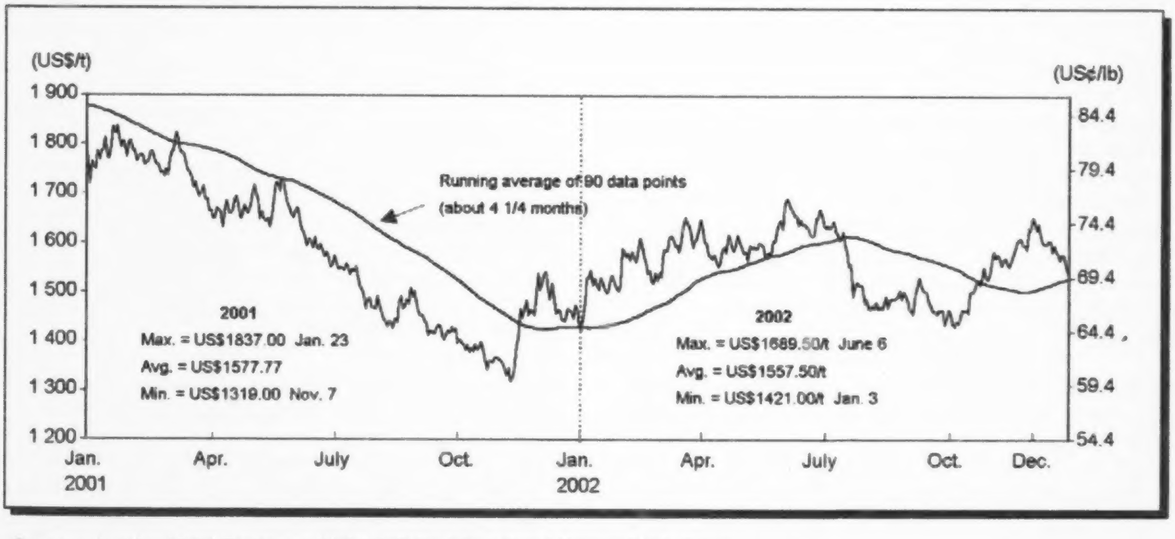
[n] COMEX data are available through links on a web page found at www.nymex.com/jsp/markets/cop_pre_agree.jsp. COMEX is a division of the New York Mercantile Exchange, Inc. (source: www.nymex.com/media/metalshedge.pdf).

Figure 11
LME Grade A Copper Daily Cash Settlement Price, 1989-2002
4 1/4 Month Running Average



Sources: London Metal Exchange; *Metal Bulletin*; International Copper Study Group.

Figure 12
LME Daily Cash Settlement Copper Price, 2001 and 2002



Sources: London Metal Exchange; *Metal Bulletin*; International Copper Study Group.

supply-demand balance and the expectation for future supply-demand balance. The price for copper received by producers normally is somewhat higher than the LME prices because of a premium associated with brand, form of the copper, location of delivery point, etc.[o] Inco Limited's realized price for copper in 2002 was US$1629/t, compared to the LME average of US$1559.50/t. The reference premium for Europe is based upon the Codelco premium, which was US$38/t established in late 2002,[294] or US1.7¢/lb. Canadian copper consumers typically purchase copper based upon the reference COMEX price plus a premium for delivery point, brand, etc.

Treatment Charges and Refining Charges

Treatment charges and refining charges (TCRCs) declined through the year as low copper prices led to declining copper production. The low TCRCs, and the expectation of continuing low TCRCs, led to the closure of the Gaspé smelter in Murdochville, Quebec, by Noranda Inc. Conversely, the low TCRCs benefited Canadian mines that sell copper concentrates.

During 2002, a number of smelters in Asia entered into two agreements to increase their negotiating power when purchasing copper concentrates.

The China United Copper Co. Ltd. was formed by five large copper smelters in China and China Minmetals Group who together accounted for an estimated 80% of Chinese copper concentrate imports and for about 70% of Chinese copper smelter output. Chinese mines provided about half the concentrate smelted in China in 2002 and this was projected to decrease to below 40% by 2010.[295]

Nippon Mining & Metals Co., Ltd. and Mitsui Mining & Smelting Co. Ltd. modified the business activities of their joint company, Pan Pacific Copper Co., Ltd. Pan Pacific Copper was formed to market copper and sulphuric acid produced by the two owners. In May, the companies announced that Pan Pacific Copper would also handle the procurement of copper concentrates for both companies in place of the joint company that they set up in 2002 to handle concentrate procurement; United Copper Resources Co., Ltd. Consequently, United Copper Resources was dissolved.[296]

Counterbalancing some of the effects of the new smelter purchasing groupings, the various producers reduced production in response to prospects for lower copper prices. Mine production in 2002 declined from the 2001 peak of over 11 Mt to the 2000 output level.[297]

As prices failed to increase, reductions in production, such as the decision to mine low-grade ore in times of low prices at the Escondida operation in Chile, thereby reducing production by 80 000 t/y (announced in November 2001),[298] the closure of 90 000 t/y of sulphide output at the Tintaya mine in Peru (also announced November 2001),[299] Codelco's cutback of 106 000 t (announced in 2001), and Codelco's decision announced in November to reduce sales by 200 000 t in 2003,[300] together reduced the amount of available copper and of copper concentrate. To take advantage of lower unit costs resulting from high capacity utilization, smelters had to offer, as illustrated below, lower TCRCs in order to try to attract sufficient feed material to run at high levels of throughput.

As TCRCs declined over the year, the lower TCRCs were termed a "catastrophe" by one unnamed European smelter, quoted in a report in early 2003 by *Metal Bulletin*. The same source reported a smelter's comments that the European smelters had grown accustomed to treatment charges of $80-$90/t (and, by implication, refining charges of US8¢-9¢/lb). This led to (European) complaints that smelters in India had an advantage due to duties on cathode and that the Chinese smelters had an advantage because of a decision to eliminate the value-added tax on copper concentrate imports.[301] One analyst was reported in mid-year 2002 as saying that with the Indian import duties, custom smelters in India could make money at TCRCs of even US$10/t and US1¢/lb.[302] However, apparently belying this claim, Hindustan Copper Ltd. had to re-issue a tender for 40 000 t of copper concentrates in May when TCRCs fell below US$40/t and US4¢/lb.[303]

In January, P.T. Freeport Indonesia Company[p] (owned by Freeport-McMoRan Copper & Gold Inc.) and the Japanese Smelter Pool reportedly negotiated TCRCs at US$70/t and 7¢/lb. This rate was 10% lower compared to a year earlier, mainly due to a shortage of concentrates. In addition, the charges on the contained gold were reduced, which in effect reduced TCRCs to the equivalent of US$68-$69/t and US6.8¢-6.9¢/lb.[304] At this time, spot TCRCs in India were said to be about US$48/t and US4.8¢/lb. A week later, it was reported that Ok Tedi Mining Limited had settled contracts with Japanese smelters for the same terms while selling spot material at US$48/t and US4.8¢/lb.[305]

In February, the Escondida mine and Mitsubishi Corporation settled for TCRCs reported to be US$68/t and US6.8¢/lb. This too represented a 10% decrease compared to the mid-2001 terms negotiated at US$76/t and US7.6¢/lb. By early April, the benchmark TCRCs in Japan were reduced slightly to US$68.5/t and US6.85¢/lb, some US$2.50/t and 0.25¢/lb above TCRCs outside of Japan.[306] In May, as noted above, Hindustan Copper Ltd. had to re-tender a bid for copper concentrates when prices were below US$40/t and US4¢/lb.

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[o] Noranda described it as a "premium negotiated above the COMEX or LME settlement price based on product form and quality, packaging, delivery terms, supply commitments, delivery location and availability of product" (Annual Information Form, 2002, p. 10).

[p] In the words of Freeport-McMoRan Copper & Gold Inc. Annual Report, 2002, "the world's single largest producer and supplier of custom copper concentrate."

In late June, Escondida negotiated mid-year terms with Japanese smelters at the rate of US$64/t and US6.4¢/lb. This deal was similar to that negotiated with the Ok Tedi mine by Mitsubishi Mining and United Copper Resources, the negotiating arm of Nippon Mining and Mitsui. The settlement was termed a decrease of $4/4¢ on previous agreements made at the start of 2002.[307] These deals came a week after an agreement reported between the PASAR (Philippine Associated Smelting and Refining Corporation) smelter in the Philippines and the Ok Tedi mine for US$61.5 and US6.15¢/lb, which included lower gold charges as negotiated earlier in the year.[308] By January 2003, it was reported that Birla Copper had contracted for 2003 at a combined TCRC of US11¢-13¢/lb compared to US15¢-16¢/lb in 2002,[309] equivalent to a decline from about US$62.50 and US6.25¢/lb to about US$47.50/t and US4.75¢/lb, or a decline of nearly 25%.

OUTLOOK

Canadian copper producers continued to face difficult times in 2002 due to the continued low prices. At some Canadian mines that produce copper, the prices of other metals are more important than copper prices in determining the profitability of the operation. Thus, not all mines in Canada that produce copper make decisions based upon the same criteria when considering new investments or whether to shut down in times of low copper prices.

The author divided the copper product from Canadian mines into categories by importance of type of metal produced. These groupings[q] were:

- copper mines: copper accounts for most of the metal value in the concentrates produced;
- zinc mines: zinc accounts for most of the metal value in the concentrates produced;
- nickel mines: nickel accounts for most of the metal value in the concentrates produced;
- precious metals mines: gold, silver, and, in one case, platinum group metals account for most of the metal value in the concentrates produced;
- co-product mines: copper accounts for more than 20% but less than 50% of metal value in concentrate produced.

The amounts of copper produced by these groupings of industry and copper's percentage of the total concentrate value has been presented in Figure 7 (note that the groupings are the author's groupings and that other groupings are possible). The following groupings were used:

- copper mines
- nickel mines
- co-product mines
- zinc mines
- precious metals mines

The "**copper mines**" evaluate mine operation principally according to copper prices; these are judged to be the Highland Valley Copper, Huckleberry and Louvicourt mines, which produce about 45% of Canadian copper and for which copper accounts for about 90% of the value of metals in concentrate produced at these mines in total.

The "**nickel mines**" evaluate mine operation principally according to nickel prices; these are judged to be Falconbridge's mines in the Sudbury Basin, the Raglan mine, and Inco's mines in the Sudbury Basin and in Manitoba, all of which produce about 25% of Canadian copper and for which copper accounts for about 15% of the value of metals in concentrate produced at these mines in total.

The "**co-product mines**" are operations in which copper is an important component of the total value of metal in concentrate (over 20% of the total value) but is not the determining factor in evaluating the mine operations (for these mines copper amounts to less than half the total value). The co-product mines are judged to be the Kidd, Kemess, Hudson Bay, and Selbaie mines, which produce about 23% of Canadian copper and for which copper accounts for about 38% of the value of the metals in concentrate produced at these mines in total. Some co-product mines have most of their revenue associated with zinc and some gold.

The "**zinc mines**" evaluate mine operation principally according to zinc prices; these are judged to be the Brunswick, Bell-Allard, Myra Falls, and Bouchard-Hébert mines, which produce about 5% of Canadian copper and whose copper accounts for about 38% of the value of metals in concentrate produced at these mines in total.

The "**precious metals mines**" evaluate mine operation principally according to the gold and palladium prices;

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[q] The values of metals in concentrates do not necessarily reflect the revenue obtainable from these metals as varying proportions of the metals are recoverable for sale. Also, the data were compiled from company reports in which most companies reported metals contained in concentrates, but some reported payable quantities and one reported only deliveries of metals. The metal for which smelters pay is less than the contained quantity. For these reasons, the grouping is general but is believed to be indicative of the decision criteria of mines producing copper in Canada.

these are judged to be the Troilus, Bousquet,[r] Joe Mann, LaRonde, and Lac des Iles mines, which produce about 2% of Canadian copper and whose copper accounts for about 7% of the value of metals in concentrate produced at these mines in total.

The price of copper is of different importance to each of the above "types" of mines. For the "copper mines," the price of copper is of prime importance in evaluations of operations, expansion, new investments at the operation, and for decisions on whether or not to shut down in times of low copper prices. In contrast, for the "precious metals mines" and "zinc mines," copper prices are relatively insignificant for the evaluation of the operations, expansion decisions, new investments at the operation, and decisions on whether or not to shut down when the mine faces difficult economic conditions. The postponement of the development of the Perserverance deposit would not likely be reversed even if the copper price were to rise by 50% so long as the zinc price remains depressed as the orebody contains 16% zinc plus precious metals, but only 1.24% copper.

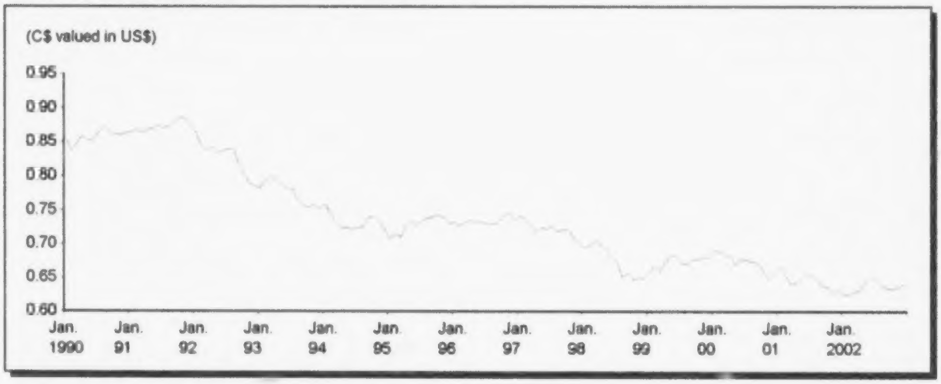
A higher copper price, of say US$1/lb, by itself would likely not result in a decision to expand output at the precious metals mines or at the zinc mines because the increased revenue would be small in proportion to total revenue. Hence, the copper production from zinc and precious metals mines is relatively insensitive to the price of copper. In contrast, copper produced at the country's "copper mines" is very sensitive to copper prices.

Many costs for Canadian producers, such as labour and supplies, are in Canadian currency. Revenues such as the LME copper price or the price at which concentrates are sold are denominated in U.S. currency. The period from late 1997 to late 2002 was a period of some relief for Canadian producers as they benefited from a lower-valued Canadian currency. Monthly average exchange rates since 1990 are shown in Figure 13. While there has been a rebound from the record low of January 2002 of US62.49¢ per Canadian dollar, the low copper prices and the appreciating Canadian currency together mean the mines face tough times.

The outlook for Canadian copper production capacity to 2007 is shown in Figure 14. Projections beyond 2007 would show a significant decrease due to the expected closure of Highland Valley Copper late in the decade, which will reduce Canadian copper production by between 150 000 and 200 000 t/y of copper in concentrates. If copper prices remain low, below US90¢/lb for the remainder of the decade, prospects are dim that new projects will make up for the expected depletion of existing producers and allow Canadian copper production to be maintained at present levels.

The opening of new mines in Canada involves obtaining many approvals. A major project in Canada is subject to federal and provincial approval processes.[s] The decisions can be challenged in court. There are also outstanding land claims by Aboriginal groups that increase uncertainty about investment decisions. Depending upon the location

Figure 13
Monthly Average Exchange Rates, 1990-2002



Source: Bank of Canada noon rates (www.bankofcanada.ca/en/exchange-avg.htm).

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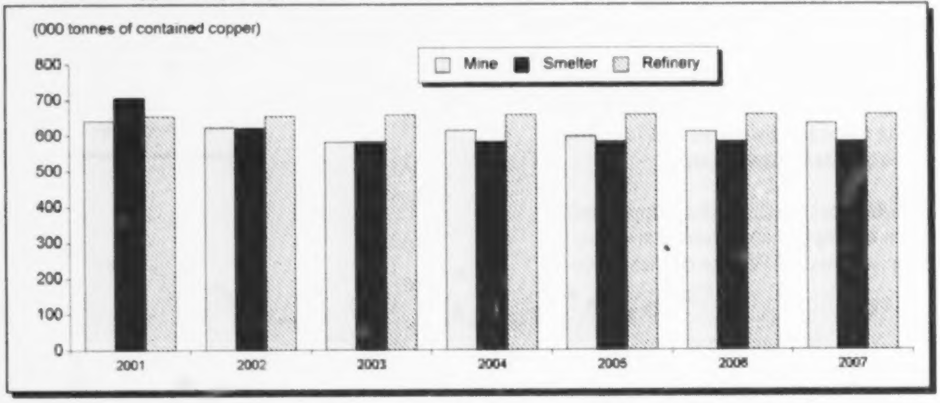
[r] Data for Bousquet production are not released and are not included in the calculations shown above; however, it was judged to be a gold mine and not a copper mine.

[s] Refer to www.ceaa-acee.gc.ca/index_e.htm for more details.

Figure 14
Canadian Copper Capacity, 2001-07



Source: International Copper Study Group, *Directory of Copper Mines and Plants*, April 2003, using data supplied by companies to Natural Resources Canada.
Note: Data reflect the closure of the Gaspé smelter in 2002.

of a new project, some producers need to negotiate Impact and Benefit Agreements with Aboriginal groups.[t]

The copper industry in many of the developing nations may be affected by the outcome of the Extractive Industries Review by the World Bank. If the World Bank either withdraws or reduces its lending role to projects in developing countries or if it imposes onerous lending conditions, then the investment and insurance costs for new projects in these countries may increase significantly. The net effect could be to decrease the competitiveness of projects in developing countries relative to developed countries such as Canada. For more details, the reader can refer to the World Bank web site at www.eireview.org/eir/eirhome.nsf.

Copper recycling in Canada is an important factor in maintaining the competivity of Canadian copper smelters. Canadian industry imports a significant amount of copper and associated metals such as platinum group metals, silver and gold. These feeds supplement conventional concentrates and the metals in the scrap are important sources of revenues. For example, Noranda Inc.'s Horne smelter has an advantage because it is particularly flexible in terms of the feed material – both in physical form and in the ability to treat complex feeds (see details above of the recycled outputs in 2001 and 2002 of the Horne and Gaspé smelters).

However, the ability of Canadian industry to match terms by U.S. competitors for materials arising from U.S. sources is hindered by the regulations governing the import and export of recyclables that have a potental to generate a leachate if buried in landfill. The *Canadian Environmental Protection Act* (CEPA) was amended in 1999. During 2002, a series of consultations took place on how to: change regulations that could facilitate access to recyclable materials, be consistent with Canada's international obligations, and reflect the policy direction in the amended CEPA that clearly differentiates between wastes for final disposal and recyclables. If new regulations put Canadian smelters on more of an even footing with respect to regulatory approvals of the U.S. destinations for recyclables, this action will contribute to removing barriers to recycling in Canada.

FURTHER INFORMATION – CANADIAN INDUSTRY

Much more information is available about copper supply, demand, and uses, as well as the health and environmental aspects of copper. Good sources of information for production are the web sites of those companies that produce copper. The list of web sites of companies with Canadian mines and projects is shown below. Securities information is available from SEDAR,[u] and the reader should be sure to use the **entire** URL address (which is quite lengthy). Many of these companies also have substantial copper production facilities outside of Canada and details about those facilities can be found in the Annual Information Forms filed yearly (similar to a 10-K form filed in the

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[t] An example is Voisey's Bay Nickel (see www.vbnc.com/iba.asp).

[u] System for Electronic Document Analysis and Retrieval, a registered trademark of the Canadian Securities Administrators, located on the Internet at www.sedar.com.

United States) and the annual reports also filed with securities regulators. The list of corporate web sites and SEDAR locations for these companies' documents is located in Table 3.

Canadian monthly data for mine production, shipments, refinery output and domestic shipments by Canadian producers can be found in three file formats at http://mmsd1.mms.nrcan.gc.ca/mmsd/ data/default_e.asp.

Additional information about the Canadian copper industry is available from a number of commercial sources, many displaying free information. Some of these sites include:

- *Canadian Mining News* (information in English, French, German, Spanish, Italian and Portuguese, located at www.canadianminingnews.com); and
- The *Goldsheet Mining Directory* is an extensive source of information about Canadian and other mining companies operating in Canada and abroad. It offers links to corporate web sites, associations and other sources of information, including government departments. A weekly update service showing new sites added is also available. The web site is located at www.goldsheetlinks.com.

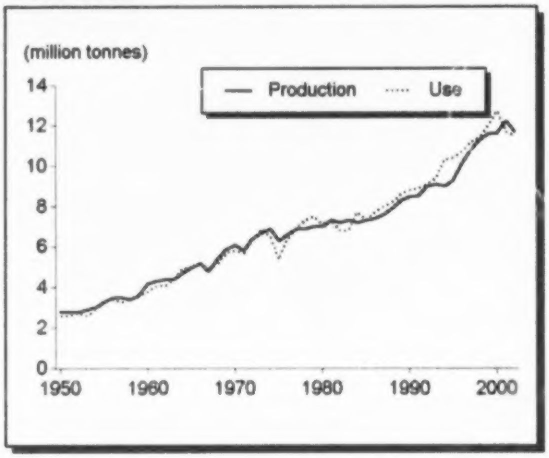
OTHER SOURCES OF COPPER INFORMATION

For copper production outside of Canada, Table 4 shows the countries and web sites of major producers.

Production, trade, and capacity data are published by the ICSG, a group consisting of 25 countries serviced by a secretariat in Lisbon, Portugal. Various publications are sold. The ICSG *Copper Bulletin* is a monthly publication, sold for US$100 or 100 euros per issue (price in non-member countries is 50% higher) (current as of the May 2003 issue). Yearly subscriptions are available. In addition, the Group sells a *Directory of Copper Mines and Plants* spanning a five-year period. The April 2003 issue price was 400 euros. Details of these and other publications are available at www.icsg.org in the "Publications" section.

Long-term data are available from the World Bureau of Metal Statistics (WBMS). The WMBS is a private company that holds the copyright for *METALLSTATISTIK*, the renowned data series formerly published by Metallgeschellshaft AG. This publication series contains production data back to 1900, as well as trade and price data. The 89th edition for the period 1991 to 2001 is sold for £420, 720 euros or US$840 (per web site, June 2003). The WBMS also publishes *World Metal Statistics* monthly, quarterly and yearly. The WBMS web site is located at www.world-bureau.com.

Figure 15
Historical Western World Copper Data, 1995-2002



Source: World Bureau of Metal Statistics.

Figure 15[v] shows the historical data for copper production and usage in the Western World from 1950 to 2002.

The historical use of copper appears to fall into two more regular growth periods (determined by the author):

- 1950 to 1973, a period for which a 4.33%/y growth rate curve can be fitted to the data; and
- 1982 to 2002, a period for which a 3.13%/y growth rate curve can be fitted to the data.

These periods are separated by a time when the demand for copper was more volatile, suggesting that growth during this time was not similar to the two periods noted above. The data from 2000 onwards look suspiciously like demand may be entering into another period of instability when growth in copper usage does not fall into a pattern described by exponential growth. These observations are illustrated in Figure 16, which shows the actual WBMS data and the curves fitted by the author for selected periods.

The **International Copper Association** (ICA) maintains a web site with information about:

- **copper products** - building products, consumer and electronic items, transportation, agriculture, industrial applications, and machinery and future applications;

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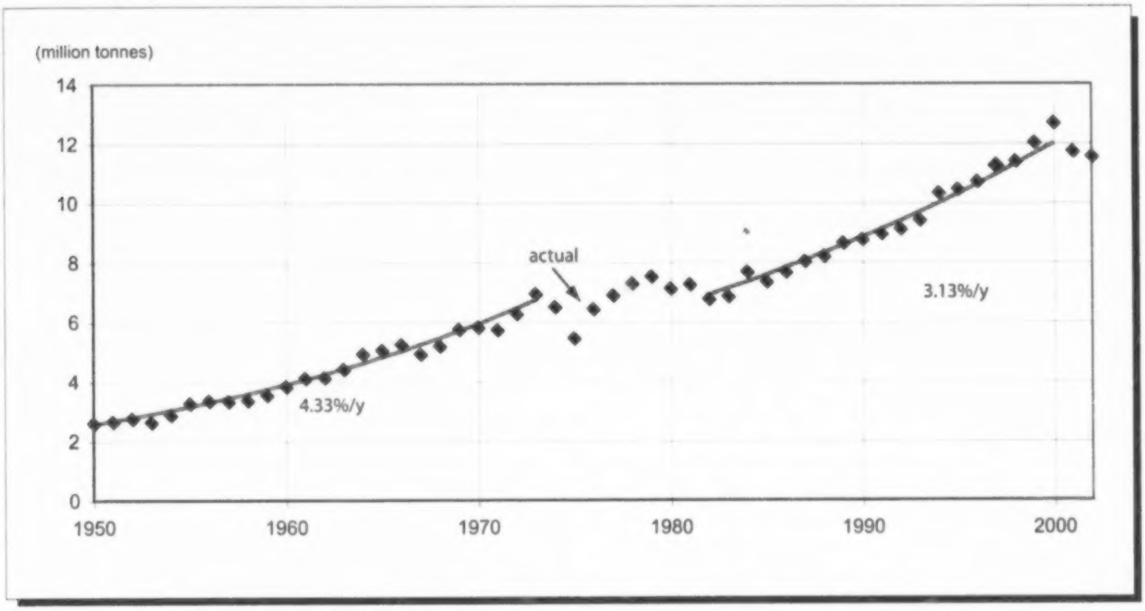
[v] Produced with the kind assistance of WBMS.

Figure 16
World Copper Use and Growth Rates, 1950-2002



Source: World Bureau of Metal Satistics for actual data; regressions by author.

- **energy efficiency** - air conditioners and refrigerators, copper bus bars, motors, power cables, solar energy, transformers, and case studies;
- **health and nutrition** - aquatic life, biological importance, copper deficiency, copper research, information flow project, drinking water, good health with copper, how much do we need?, plant and animal health, pregnancy and infants, public health benefits, quick facts, ICA research;
- **environment** - climate change mitigation, copper research information flow project, energy conservation, natural presence, recycling, sustainability, ICA research; and
- **about copper** - copper alloys, copper exchanges, copper markets, copper mining, copper products.

The web site for the International Copper Association is located at www.copperinfo.com/index4.shtml.

One of the more interesting destinations from the ICA site is an online history of copper. This site provides material of interest to students and others seeking an overview of the history of copper. This can be found at http://60centuries.copper.org.

Information about copper use is available from the **International Wrought Copper Council** (IWCC). The publication *World Trade in Copper and Copper Alloy Semi-Manufactures, 2001* is sold containing data for 21 countries for 2001 and the three previous years. The cost is £450 for non-members. The *Survey of Capacities of Copper Mines, Smelters, Refineries, and Copper Wire Rod Plants,* April 2002, covering 1999 to 2007, is sold for £250 to non-members. The site has links to member companies and organizations. The IWCC site is located at www.coppercouncil.org.

The USGS publishes monthly and annual data as well as detailed geographic reviews. The copper portal is located at http://minerals.usgs.gov/minerals/pubs/commodity/copper.

Historical statistics for copper and for other metals and minerals in the United States are available in pdf, html and spreadsheet format from a general listing available at http://minerals.usgs.gov/minerals/pubs/of01-006.

Specifically, the copper data in the three formats are found at:

- pdf format – http://minerals.usgs.gov/minerals/pubs/of01-006/copper.pdf
- spreadsheet format – http://minerals.usgs.gov/minerals/pubs/of01-006/copper.xls
- html format – http://minerals.usgs.gov/minerals/pubs/of01-006/copper.html

Historical world information compiled by the USGS about mine, smelter and refinery production by country for the years 1986-90 can be found at:

- mine – http://minerals.usgs.gov/minerals/pubs/commodity/copper/stat/tbl12.txt
- smelter – http://minerals.usgs.gov/minerals/pubs/commodity/copper/stat/tbl13.txt
- refinery – http://minerals.usgs.gov/minerals/pubs/commodity/copper/stat/tbl14.txt

The USGS historical copper consumption data in the United States for the years 1970-90 are available for five consuming sectors: wire-rod mills, brass mills, chemical plants, ingotmakers, and foundries. These data can be found at http://minerals.usgs.gov/minerals/pubs/commodity/copper/stat/tbl5.txt.

CONVERSIONS

Conversion between metric and imperial units is available on the Internet at www.worldwidemetric.com/metcal.htm and conversions relating to precious metals, which are often measured in troy ounces, are located on the Internet at www.goldcalculator.com/index_files/page0033.htm and www.hallmark-gemstones.com/metalinfo.html.

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270 The Getty Copper Highland Valley Project Reports: A Technical Review, December 2002, and modified in February 2003, p. 21.

271 The Getty Copper Highland Valley Project Reports: A Technical Review, December 2002, and modified in February 2003, p. 12.

272 Getty Copper Corporation, press release, May 23, 2002.

273 Taseko Mines Limited, Report for quarter ending December 31, 2002, p. 11.

[274] Taseko Mines Limited, Report for quarter ending December 31, 2002, p. 11.

[275] Taseko Mines Limited, B.C. Form 51-901 for quarter ending December 31, 2002, Schedule C.

[276] Taseko Mines Limited, Annual Information Form for year ending September 30, 2003, pp. 8 and 9.

[277] Taseko Mines Limited, Annual Information Form for year ending September 30, 2001, p. 12.

[278] Taseko Mines Limited, Annual Information Form for year ending September 30, 2001, p. 13.

[279] Taseko Mines Limited, letter to shareholders, February 17, 2003.

[280] Taseko Mines Limited, Annual Information Form for year ending September 30, 2003, p. 7.

[281] Taseko Mines Limited, Annual Information Form for year ending September 30, 2003, p. 8.

[282] Taseko Mines Limited, Annual Information Form for year ending September 30, 2003, p. 9.

[283] Taseko Mines Limited, letter to shareholders, February 17, 2003.

[284] Taseko Mines Limited, Annual Information Form for year ending September 30, 2002, pp. 12-19.

[285] International Copper Study Group, *Copper Bulletin*, May 2003.

[286] International Iron and Steel Institute, press release, January 20, 2003, at www.steelnews.com/news/jan03/jan82.htm.

[287] International Aluminium Institute, Statistical Report, *Primary Aluminum Production*, Form 150, June 2003, available at www.world-aluminium.org/iai/stats/pdf_files/150.pdf. However, when the reader accesses the IAI site, the latest statistics, which are updated monthly, are found by going to www.world-aluminium.org/iai/stats/formServer. asp?form=1.

[288] The recorded secondary production from the IAI for each year from 1997 to 2001 was 2.18 Mt, 2.14 Mt, 2.18 Mt, 2.24 Mt and 2.22 Mt, respectively; the author estimated that 2002 would be in the same order, or about 2.2 Mt. The IAI's Statistical Report *Aluminium Recovered from Scrap*, Form 750, April 2002, is available at www.world-aluminium.org/iai/stats/formServer.asp?form=6 (note: these data are updated regularly; therefore, depending upon when the reader accesses the site, the April 2002 data may or may not be accessible).

[289] International Copper Study Group, *Copper Bulletin*, May 2003, p. 19.

[290] Danish Exporters web site at www.danishexporters.dk/_denmark/denmark_countryandpop.asp; another site, http://populations.com/country.asp?ID=47, also shows population at 5.37 million.

[291] Royal Canadian Mint, Circulation Coins, Technical Specifications, at www.mint.ca/en/collectors_corner/circulation/technical_specs_1.htm?cookie%5Ftest=1.

[292] World population projected at 6.228 billion as of July 1, 2002, by the U.S. Census Bureau – see www.census.gov/cgi-bin/ipc/popclockw; copper usage for world shown as 15.069 Mt by ICSG in *Copper Bulletin*, May 2003, p. 19.

[293] International Copper Study Group, *Copper Bulletin*, May 2002, p. 19.

[294] Web site at www.kghm.pl/en/oferta02-4.php.

[295] *Metal Bulletin*, October 28, 2002.

[296] *Metal Bulletin*, May 31, 2002, and Nippon Mining & Metals Co. Ltd., press release, May 30, 2002, at www.nikko-metal.co.jp/english/corporate/news.html.

[297] *Copper Bulletin*, International Copper Study Group, April 2003, p. 10.

[298] BHP Billiton Plc, Press Release, November 8, 2001, number 31/01.

[299] BHP Billiton Plc, Press Release, November 8, 2001, number 31/01.

[300] Codelco Limited, referenced in Press Release, April 14, 2003.

[301] *Metal Bulletin*, February 6, 2003.

[302] *Metal Bulletin*, June 10, 2002.

[303] *Metal Bulletin*, May 13, 2003.

[304] *Metal Bulletin*, January 17, 2002.

[305] *Metal Bulletin*, January 24, 2002.

[306] *Metal Bulletin*, April 8, 2002.

[307] *Metal Bulletin*, June 25, 2002.

[308] *Metal Bulletin*, June 17, 2002.

[309] *Metal Bulletin*, January 17, 2003.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of November 2003. (3) Various Internet sites have been identified in this article. Please note that Natural Resources Canada has no control over the content of the web sites of other organizations, which may be modified, updated or deleted at any time. (4) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

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TARIFFS

		Canada			United States	EU	Japan
Item No.	Description	MFN	GPT	USA	Canada	MFN	WTO (1)
2603.00	Copper ores and concentrates						
2603.00.00.10	Copper content	Free	Free	Free	Free	Free	Free
2825.50	Copper oxides and hydroxides	Free	Free	Free	Free	3.2%	4.8%
28.33	Sulphates; alums; peroxosulphates (persulphates)						
	Other sulphates:						
2833.25	Of copper						
2833.25.10	Cupric sulphate	Free	Free	Free	Free	3.2%	3.9%
2833.25.90	Other copper sulphates	5.5%	Free	Free	Free	3.2%	3.9%
74.01	Copper mattes; cement copper (precipitated copper)						
7401.10	Copper mattes	Free	Free	Free	Free	Free	Free
7401.20	Cement copper (precipitated copper)	Free	Free	Free	Free	Free	Free
7402.00	Unrefined copper; copper anodes for electrolytic refining	Free	Free	Free	Free	Free	Free-3%
74.03	Refined copper and copper alloys, unwrought						
	Refined copper:						
7403.11	Cathodes and sections of cathodes	Free	Free	Free	Free	Free	Free-3%
7403.12	Wire bars	Free	Free	Free	Free	Free	Free-3%
7403.13	Billets	Free	Free	Free	Free	Free	Free-3%
7403.19	Other	Free	Free	Free	Free	Free	Free-3%
	Copper alloys:						
7403.21	Copper-zinc base alloys (brass)	Free	Free	Free	Free	Free	Free
7403.22	Copper-tin base alloys (bronze)	Free	Free	Free	Free	Free	Free-3%
7403.23	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel-silver)	Free	Free	Free	Free	Free	Free-3%
7403.29	Other copper alloys (other than master alloys of heading no. 74.05)	Free	Free	Free	Free	Free	Free-3%
7404.00	Copper waste and scrap	Free	Free	Free	Free	Free	Free
7405.00	Master alloys of copper	Free	Free	Free	Free	Free	3%
74.06	Copper powders and flakes	Free	Free	Free	Free	Free	3%
74.07	Copper bars, rods and profiles of refined copper	Free-3%	Free	Free	Free	4.8%	3%
74.08	Copper wire of refined copper	Free-3%	Free	Free	Free	4.8%	3%
74.09	Copper plates, sheets and strip of a thickness exceeding 0.15 mm	Free	Free	Free	Free	4.8%	3%
74.10	Copper foil (whether or not printed or backed with paper, paperboard, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0.15 mm	Free	Free	Free	Free	5.2%	3%
74.11	Copper tubes and pipes	2-2.5%	Free	Free	Free	4.8%	3%
74.12	Copper tube or pipe fittings (for example, couplings, elbows, sleeves)	3%	Free	Free	Free	5.2%	Free
7413.00	Stranded wire, cables, plaited bands and the like, of copper, not electrically insulated	3%	Free	Free	Free	Free-5.2%	3%
74.14	Cloth (including endless bands), grill and netting, of copper wire; expanded metal of copper	3%	Free	Free	Free	4.3%	Free
74.15	Nails, tacks, drawing pins, staples (other than those of heading no. 83.05) and similar articles, of copper or of iron or steel with heads of copper; screws, bolts, nuts, screw hooks, rivets, cotters, cotter-pins, washers (including spring washers) and similar articles, of copper	Free-3%	Free	Free	Free	3-4%	Free
7416.00	Copper springs	3%	Free	Free	Free	4%	Free
7417.00	Cooking or heating apparatus of a kind used for domestic purposes, non-electric and parts thereof, of copper	3%	Free	Free	Free	4%	Free
74.18	Table, kitchen or other household articles and parts thereof, of copper; pot scourers and scouring or polishing pads, gloves and the like, of copper; sanitary ware and parts thereof, of copper	3%	Free	Free	Free	3%	Free
74.19	Other articles of copper	Free-9.5%	Free-5%	Free	Free	3%	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002); *Customs Tariff Schedules of Japan*, 2003.
(1) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, COPPER PRODUCTION AND TRADE, 2001 AND 2002

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
MINE PRODUCTION (1)		683 531	–	600 187	–
SHIPMENTS (2)					
	Newfoundland and Labrador	–	–	–	–
	Prince Edward Island	–	–	–	–
	Nova Scotia	–	–	–	–
	New Brunswick	9 048	22 611	8 994	22 116
	Quebec	98 014	244 937	86 716	231 235
	Ontario	182 336	455 658	189 756	466 611
	Manitoba	38 872	97 142	37 758	92 847
	Saskatchewan	10 796	26 979	10 080	24 787
	Alberta	–	–	–	–
	British Columbia	275 245	687 838	243 729	599 328
	Yukon	–	–	–	–
	Northwest Territories	–	–	–	–
	Total	614 312	1 535 165	577 033	1 418 923
	Refinery output	567 720	. .	495 140	. .
EXPORTS					
2603.00.10	Copper ores and concentrates				
	Copper content				
	Japan	(a) 382 576	279 052	(b) 167 962	185 757
	China	(a) 111187	84 743	(b) 59 307	63 098
	South Korea	(a) 64154	49 887	(b) 23 197	46 145
	India	(a) 21433	16 754	(b) 16 281	32 171
	Other countries	(a) 50 662	43 900	(b) 16 206	28 570
	Total	630 012	474 336	282 953	355 741

(Note: Canadian copper concentrate data as shown by Statistics Canada are believed to be incorrect for 2000, 2001 and 2002. Data for those years appear to show the tonnage of copper concentrate shipments and not the tonnes of copper contained in concentrates. This results in a serious over-estimation of the copper exports from Canada. An attempt will be made to reconstruct the trade data for these years; a provisional correction based only upon unit value has been shown for 2002. Therefore, the numbers reported above based upon official data should be considered incorrect.)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
2604.00.00.10, 2607.00.00.10, 2608.00.00.10, 2616.10.00.10	Other ores and concentrates				
	Copper content				
	Finland	4 050	2 673	–	–
2620.30	Copper ash and residues				
	United States	43	106	64	155
	Germany	–	–	20	34
	Total	43	106	84	189
2825.50	Copper oxides and hydroxides	. . .	1	–	–
2833.25	Copper sulphates				
	United States	5 601	7 241	5 939	7 799
	Cuba	. . .	. . .	–	–
	Total	5 601	7 241	5 939	7 799
7401.10	Copper mattes				
	Norway	16 031	34 655	18 971	37 838
	Other countries	21	48	–	–
	Total	16 052	34 703	18 971	37 838
7401.20	Copper mattes; cement copper (precipitated copper)				
	Japan	–	–	3 438	322
	United States	–	–	. . .	4
	Total	–	–	3 438	326
7402.00	Copper anodes				
	United States	80 108	364 768	84 118	387 596

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7403.11 to	Refined copper and copper alloys,				
7403.19	unwrought				
	United States	270 328	706 128	234 538	594 156
	Colombia	3 747	17 732	2 747	13 195
	United Kingdom	23 812	64 445	702	1 916
	Dominican Republic	316	1 505	98	479
	Other countries	10 694	28 766	33	191
	Total	308 897	818 576	238 118	609 937
7403.21 to	Copper alloys and other copper alloys				
7403.29	United States	2 737	8 827	3 059	10 065
	Other countries	8	59	6	16
	Total	2 745	8 886	3 065	10 081
7404.00	Copper waste and scrap				
	United States	56 447	110 866	52 621	113 670
	China	8 539	12 978	13 771	17 533
	Germany	1 672	2 997	1 052	1 635
	India	1 423	2 277	1 016	1 479
	South Korea	594	825	556	1 133
	Taiwan	309	608	477	988
	Hong Kong	138	265	411	607
	Other countries	1 123	2 072	1 294	1 497
	Total	70 245	132 888	71 198	138 542
7405.00	Master alloys of copper				
	United States	–	–	–	–
7406.10 to	Copper powders and flakes				
7406.20	United States	33	237	282	678
	Taiwan	24	259	23	232
	Other countries	23	196	25	239
	Total	80	692	330	1 149
7407.10 to	Copper bars, rods and profiles of				
7407.29	refined copper				
	United States	6 630	29 348	5 539	24 562
	Chile	161	725	129	590
	Other countries	46	244	29	152
	Total	6 837	30 317	5 697	25 304
7408.11 to	Copper wire of refined copper and of copper alloys				
7408.29	United States	112 831	323 017	131 632	369 048
	Argentina	4	62	25	164
	Other countries	14	132	82	336
	Total	112 849	323 211	131 739	369 548
7409.11 to	Copper plates, sheets, strip and foil of				
7410.22	refined copper and of copper alloys				
	United States	11 278	56 534	4 695	19 830
	Taiwan	350	1 571	203	779
	Thailand	964	3 519	198	682
	Hong Kong	...	...	77	432
	Saudi Arabia	534	2 397	94	253
	Australia	157	725	47	246
	Other countries	2 418	9 802	103	405
	Total	15 701	74 548	5 417	22 627

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7411.10 to 7411.29	Copper tubes and pipes of refined copper and of copper alloys				
	United States	18 203	110 002	18 852	115 929
	Singapore	43	324	45	307
	Netherlands	529	3 307	38	253
	United Kingdom	130	984	31	224
	Australia	74	728	28	200
	Other countries	283	1 956	143	797
	Total	19 262	117 301	19 137	117 710
7412.10 to 7412.20	Copper tube and pipe fittings of refined copper and of copper alloys				
	United States	. .	37 714	. .	36 561
	France	. .	969	. .	483
	Germany	. .	1 612	. .	457
	Sweden	. .	815	. .	356
	Spain	. .	3 403	. .	140
	Other countries	. .	3 836	. .	626
	Total	. .	48 349	. .	38 623
7413.00	Stranded wire, cables, plaited bands and the like, of copper, not electrically insulated				
	United States	1 013	6 012	722	5 900
	Other countries	21	63	41	409
	Total	1 034	54 424	763	6 309
7414, 7415, 7416, 7419	Other items of copper				
	United States	. .	40 292	. .	34 026
	Other countries	. .	934	. .	2 916
	Total	. .	41 226	. .	36 942
	Total exports		2 566 260		2 479 731
IMPORTS (3)					
2603.00.00.10	Copper ores and concentrates				
	Copper content				
	Chile	(a) 106 849	206 436	(b) 51 600	105 019
	United States	(a) 29 468	65 525	(b) 16 510	47 417
	Peru	(a) 19 516	31 061	(b) 22 414	41 981
	Belgium	–	–	(b) 10 055	25 107
	Portugal	(a) 14 573	23 371	(b) 10 340	17 502
	Argentina	(a) 17 258	36 451	(b) 6 813	13 519
	Other countries	(a) 31 869	65 740	(b) 9 959	19 793
	Total	219 533	428 584	127 691	270 338

(Note: Canadian copper concentrate data as shown by Statistics Canada are believed to be incorrect for 2000, 2001 and 2002. Data for those years appear to show the tonnage of copper concentrate shipments and not the tonnes of copper contained in concentrates. This results in a serious over-estimation of the copper exports from Canada. An attempt will be made to reconstruct the trade data for these years; a provisional correction based only upon unit value has been shown for 2002. Therefore, the numbers reported above based upon official data should be considered incorrect. Imports shown as originating in Belgium likely originated in another country.)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
2604.00.00.10, 2607.00.00.10, 2608.00.00.10, 2616.10.00.10	Other ores and concentrates				
	Copper content				
	United States	285	502	192	313
	Mexico	129	246	–	–
	Total	414	748	192	313
2620.30	Copper ash and residues				
	Portugal	–	–	13 404	4 739
	United States	6 880	9 958	2 686	4 586
	Sweden	923	1 753	557	1 552
	Spain	1 213	339	19	286
	Other countries	893	540	526	324
	Total	9 909	12 590	17 192	11 487

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
2825.50	Copper oxides and hydroxides	1 390	3 894	1 281	3 715
2833.25	Copper sulphates	19 145	15 888	18 851	17 055
2836.99.10.20	Copper carbonates	. .	4	. .	8
2836.99.90.10	Other copper carbonates	6	13	9	19
2837.19.00.10	Copper cyanides	47	298	35	210
3212.90.90.12	Pigments based on copper or copper alloy powders and flakes	19	222	9	109
7401.10	Copper mattes	2	6	100	367
7401.20	Copper mattes; cement copper (precipitated copper)	145	295	177	549
7402.00	Copper anodes	30 562	67 171	58 487	129 263
7403.11 to 7403.19	Refined copper and copper alloys, unwrought				
	Refined copper	7 993	22 863	11 569	31 053
7403.21 to 7403.29	Refined copper and copper alloys, unwrought				
	Other copper alloys	8 495	29 702	7 260	27 096
7404.00	Copper waste and scrap				
	United States	72 401	128 765	39 119	67 629
	Cuba	781	1 346	1 257	1 823
	United Kingdom	169	564	270	1 085
	Japan	. . .	. . .	323	983
	Haiti	171	334	217	394
	Other countries	17 563	28 845	162	236
	Total	91 085	159 854	41 348	72 150
7405.00	Master alloys of copper	310	1 328	485	2 034
7406.10 to 7406.20	Copper powders and flakes	2 043	10 456	2 159	10 734
7407.10 to	Copper bars, rods and profiles of refined copper				
7407.29	United States	30 277	100 680	32 731	103 912
	Poland	2 928	6 092	1 308	2 925
	South Korea	2 023	3 699	953	1 304
	New Zealand	220	866	248	920
	Other countries	2 305	8 031	1 563	5 029
	Total	37 753	119 368	36 803	114 090
7408.11 to 7408.29	Copper wire of refined copper and of copper alloys	24 734	82 197	22 712	76 351
7409.11 to 7409.90, 7410.11 to 7410.22	Copper and copper alloy plates, sheets, strip and foil	37 265	211 764	27 875	172 525
7411.10	Pipes and tubes, refined copper	8 145	38 564	9 869	43 887
7411.21	Pipes and tubes, copper-zinc base alloys	4 658	22 937	4 740	25 085
7411.22	Pipes and tubes, copper-nickel base alloys or copper-nickel-zinc base alloys	414	2 726	402	2 834
7411.29	Plates and tubes, copper alloys, n.e.s.	2 338	14 332	852	4 894
7412.10	Fittings, pipe or tube, of refined copper	954	12 317	1 273	15 227
7412.20	Fittings, pipe or tube, copper alloys	5 619	71 789	6 569	79 668
7413.00	Stranded wire, cable, plaited bands and the like, of copper, not electrically insulated	8 402	34 772	8 632	31 711

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7414.20	Endless bands of copper wire for machinery	. .	357	. .	227
7414.90	Cloth, grill and netting of copper wire and expanded metal of copper	213	916	180	851
7415.10	Nails, tacks, drawing pins, staples and similar articles of copper or of iron or steel with copper heads	154	913	179	1 072
7415.21	Copper washers, including spring washers	275	1 685	434	3 055
7415.29	Articles of copper, not threaded, n.e.s., similar to those of headings 7415.10 and 7415.21	954	5 012	904	4 802
7415.31	Copper screws, for wood	34	208	–	–
7415.32 (4)	Screws, bolts and nuts of copper, excluding wood screws	1 220	6 213	–	–
7415.33 (4)	Screws, bolts and nuts of copper, excluding wood screws	–	–	1 457	6 316
7415.39	Articles of copper, threaded, n.e.s., similar to bolts, nuts and screws	684	3 628	895	4 513
7416.00	Copper springs	. .	483	. .	935
7419.10	Chain and parts thereof of copper	62	394	58	427
7419.91	Articles of copper, not further worked than cast, moulded, stamped or forged	3 262	25 568	3 920	26 043
7419.99	Articles of copper, n.e.s.	. .	49 320	. .	48 815
	Total imports		1 459 379		1 239 833

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary.
(a) Data believed to be tonnage of concentrates and not tonnes of copper in concentrate. (b) Tonnage of concentrates adjusted by unit value and may not reflect tonnes of copper in concentrates.
(1) Copper contained in concentrates produced. (2) Anode copper recovered in Canada from domestic concentrates plus exports of payable copper in concentrate and matte. (3) Imports from "other countries" may include re-imports from Canada. (4) HS code changed from 7415.32 to 7415.33 as of 2002.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, COPPER PRODUCTION, TRADE(1) AND USE, 1975, 1980 AND 1985-2002

	Production		Exports			Imports	Use (3)
	Shipments (2)	Refinery Output	Concentrates and Matte	Refined	Total	Refined	Refined
				(tonnes)			
1975	733 826	529 197	314 518	320 705	635 223	10 908	196 106
1980	716 363	505 238	286 076	335 022	621 098	13 466	208 590
1985	738 637	499 626	320 619	280 033	600 652	19 131	222 466
1986	698 527	493 445	341 390	306 822	648 212	20 901	225 586
1987	794 149	491 124	381 126	288 800	669 926	16 583	231 288
1988	758 478	528 723	348 404	268 680	617 084	4 659	236 280
1989	704 432	515 216	348 739	321 690	670 429	4 408	213 046
1990	771 433	515 835	374 875	335 941	710 816	2 611	180 605
1991	780 362	538 339	348 080	377 985	726 065	2 321	159 170
1992	761 694	539 302	346 842	385 761	732 603	8 916	156 132
1993	709 650	561 580	319 840	408 364	728 204	21 155	185 565
1994	590 784	549 869	237 554	388 568	626 122	(r) 19 594	(r) 199 350
1995	700 843	572 616	(r) 274 493	(r) 434 693	(r) 709 186	(r) 24 176	(r) 189 550
1996	652 499	559 200	409 577	384 338	793 915	28 700	218 280
1997	647 779	560 582	515 547	381 476	897 023	22 602	224 777
1998	690 762	562 261	450 867	355 825	806 692	18 685	246 212
1999	581 583	548 563	(r) 355 838	294 106	(r) 649 944	(r) 16 475	(r) 266 505
2000	621 889	551 393	(a) 693 016	288 335	981 351	11 874	272 075
2001 (p)	614 312	567 720	(a) 650 114	308 897	1 217 834	7 993	265 209
2002 (p)	577 033	495 140	(a) 301 924	238 118	797 064	11 569	272 042

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary; (r) Revised.
(a) Data believed to be tonnage of concentrates and not tonnes of copper in concentrate. (b) Tonnage of concentrates adjusted by unit value and may not reflect tonnes of copper in concentrates.
(1) Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. (2) From 1975 to 1988, anode copper recovered in Canada from domestic concentrate plus exports of payable copper in concentrates and matte. Starting in 1989 to date, recoverable copper in concentrate shipped, except for 2000, 2001 and 2002 (see notes a and b). (3) Producers' domestic shipments of refined copper plus imports of refined shapes.

TABLE 3. CORPORATE INTERNET AND SEDAR SITES

Company	Web Site Address	SEDAR Site Address
Agnico Eagles Mines Limited	www.agnico-eagle.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00000834&lang=EN
Aur Resources Inc.	www.aurresources.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00002420&lang=EN
Barrick Gold Corporation	www.barrick.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00000923&lang=EN
Billiton Metals Canada Inc.	(see BHP Billiton Plc)	(no location found)
Boliden Westmin (Canada) Limited	www.boliden.ca/index.htm	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00017238&lang=EN
Breakwater Resources Ltd.	www.breakwater.ca	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00002929&lang=EN
Callinan Mines Limited	www.callinan.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00008418&lang=EN
Campbell Resources Inc.	www.ressourcescampbell.com/en/index.html	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001579&lang=EN
DRC Resources Corporation	www.drcresources.com/s/Home.asp	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00004818&lang=EN
Expatriate Resources Ltd.	www.expatriateresources.com/start.htm	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00005621&lang=EN
Falconbridge Limited	www.falconbridge.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00000376&lang=EN
Getty Copper Corporation	www.gettycopper.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00002550&lang=EN
Highland Valley Copper	(see Teck Cominco Limited and BHP Billiton Plc)	(see Teck Cominco Limited)
Hudson Bay Mining and Smelting Co., Ltd.	(see Anglo American plc)	(no location found - not a publicly traded company in Canada)
Imperial Metals Corporation	www.imperialmetals.com/s/Home.asp	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00017753&lang=EN
Inco Limited	www.inco.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001084&lang=EN
Inmet Mining Corporation	www.inmetmining.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00003181&lang=EN
Minto Explorations Limited	(discontinued)	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00005603&lang=EN
MSV Resources Inc.	(not found)	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00002877&lang=EN
Noranda Inc.	www.noranda.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00004438&lang=EN
North America Palladium Ltd.	www.napalladium.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00003026&lang=EN
Northgate Exploration Ltd.	www.northgateexploration.ca	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001913&lang=EN
Novicourt Inc.	(not found)	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001886&lang=EN
Placer Dome Inc.	www.placerdome.com/index.jsp	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00002304&lang=EN
Redcorp Ventures Ltd.	www.redcorp-ventures.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00014660&lang=EN
Taseko Mines Limited	www.tasekomines.com/tko/Home.asp	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00003212&lang=EN
Teck Cominco Limited	www.teckcominco.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001787&lang=EN
Voiseys Bay Nickel Company Limited	www.vbnc.com and www.inco.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001084&lang=EN

Source: Natural Resources Canada.

Note: SEDAR = System for Electronic Document Analysis and Retrieval (see www.sedar.com).

TABLE 4. FOREIGN COPPER PRODUCERS

Country	Company	Web Site Address
Australia	M.I.M. Holdings Limited	www.mim.com.au
	WMC Resources Ltd	www.wmc.com
Belgium	Umicore Group	www.um.be
Brazil	Companhia Vale do Rio Doce (CVRD)	www.vale.com.br
Chile	Antofagasta Holdings	www.aminerals.cl
	Corporación Nacional del Cobre de Chile	www.codelco.com
	Compañía Minera Doña Inés de Collahuasi	www.collahuasi.cl
	Empresa Nacional de Minerià (ENAMI)	www.enami.cl
	Minera Escondida Limitada	www.escondida.cl
China	Jiangxi Copper Company Limited	www.jxcc.com/english/engfgs/enindex.htm
	Jinchuan Group Limited	www.jnmc.com/default.asp
	Yunnan Copper Industrial Corp. Ltd.	www.yunnan-copper.com/ehtml/copper.html
India	Birla Copper	www.birlacopper.com
	Hindustan Copper Ltd. (HCL)	www.hindustancopper.com
	Sterlite Industries (India) Limited	www.sterlite.com/metal/copper1.html
Indonesia	Freeport-McMoRan Copper & Gold Inc.	www.fcx.com
Japan	Dowa Mining Co., Ltd.	www.dowa.co.jp
	Furukawa Electric Co., Ltd.	www.furukawa.co.jp/english/index.htm
	Mitsubishi Materials Corporation	www.mmc.co.jp/english/top_e.html
	Mitsubishi Group	www.mitsubishi.or.jp/e/contents/contents_2.html
	Mitsui & Co., Ltd.	www.mitsui.co.jp/tkabz/english/index.html
	Nippon Mining & Metals Co., Ltd.	www.nikko-metal.co.jp
	Nittetsu Mining Co., Ltd.	www.nittetsukou.co.jp
	Onahama Smelting and Refining Co., Ltd.	http://group.mmc.co.jp/osr/eng
	Dowa Mining Co., Ltd.	www.dowa.co.jp/english/index.htm
	Sumitomo Metal Mining Co., Ltd.	www.smm.co.jp/index_E.html
Kazakhstan	Zhezkazkantsvetmet *	www.samsungamerica.com/metal.asp
Korea	LG-Nikko Copper Inc.	www.lgnikko.com/eng/#
Mexico	Grupo México S.A. de C.V.	www.gmexico.com/indexi.html
Peru	Centromín Peru S.A.	www.centromin.com.pe
	Southern Peru Copper Corporation	www.southernperu.com/pages/home.htm
PNG	Ok Tedi Mining Limited	www.oktedi.com
Phillipines	Phillipine Associated Smelting & Refining Corp.	www.pasar.net.ph
Poland	KGHM Polska Miedz S.A.	www.kghm.pl/en/index.php
Rumania	Pidrop smelter	www.um.be
Russia	MMC Norilsk Nickel	www.nornik.ru/index.jsp?lang=E
United Kingdom	Anglo American plc	www.angloamerican.co.uk
	BHP Billiton Plc	www.bhpbilliton.com
	Rio Tinto plc	www.riotinto.com
United States	ASARCO Incorporated	www.asarco.com
	Kennecott Utah Copper Corporation	www.kennecott.com
	Phelps Dodge Corporation	www.phelpsdodge.com

* Zhezkazhants is owned by Samsung Deutschland GmbH.

TABLE 5. COPPER AND COPPER-NICKEL SMELTERS IN CANADA, 2002

Company and Location	Product	Rated Annual Capacity (1)	Feed Material	Remarks
Falconbridge Limited Falconbridge, Ontario	Copper-nickel matte	20 000 t/y	Nickel-copper concentrates	Copper-nickel concentrate processed in fluid bed roasters and an electric furnace; 1800-t/d sulphuric acid plant treats roaster gases. Matte from the smelter is refined in Norway.
Inco Limited Sudbury, Ontario	Molten "blister" copper, nickel sulphide and nickel sinter for the company's refineries; nickel oxide sinter for market, soluble nickel oxide for market	135 000 t/y	Bulk nickel-copper concentrates, scrap	Oxygen flash furnace for smelting of nickel-copper concentrate; converters for production of nickel-copper Bessemer matte. Production of matte followed by matte treatment, flotation, separation of copper and nickel sulphides, then by roasting to make nickel oxides for refining and marketing. Oxygen flash conversion of copper sulphide to semi-blister followed by pyrorefining to blister copper. Copper is refined at Inco's nearby refinery in Sudbury.
Falconbridge Limited Timmins, Ontario	Molten "blister" copper	140 000 t/y	Copper concentrates, scrap	Mitsubishi-type smelting, separation and converting furnaces. Hazelett continuous cast anodes. Incremental expansion increased capacity to 140 000 t/y in 1999.
Noranda Inc. Horne smelter Rouyn-Noranda, Quebec	Copper anodes	200 000 t/y	Copper concentrates, scrap	New continuous converter commissioned in 1997.
Hudson Bay Mining and Smelting Co., Limited Flin Flon, Manitoba	Copper anodes	90 000 t/y	Copper concentrates	Five roasting furnaces, one reverberatory furnace and two converters. Modernization planned but delayed indefinitely.
Total capacity December 2002		585 000 t/y		
Noranda Inc. Gaspé smelter Murdochville, Quebec	Copper anodes	Closed April 2002, capacity was 135 000 t/y	Copper concentrates	Green charge reverberatory furnace, three converters, one rotary anode furnace and an acid plant.
Thus, total capacity in January 2002 was		620 000 t/y		

Source: Data were provided by the companies listed.
(1) Copper in matte, blister and anode.

TABLE 6. COPPER REFINERIES IN CANADA, 2002

Company and Location	Rated Annual Capacity	Remarks
	(tonnes)	
CCR refinery Noranda Inc. Montréal-Est, Quebec	360 000	Refines anodes from Noranda's Horne and Gaspé smelters, and also from purchased scrap and anode scrap. Precious metals, selenium and tellurium are recovered from slimes. Modernization program completed in July 1999 raised capacity to 360 000 t/y.
Inco Limited Copper Cliff, Ontario	140 000	Casts and refines anodes from molten converter copper from the Copper Cliff smelter and also refines purchased scrap. Gold, silver, selenium and tellurium cake are recovered from anode slimes. Recovers and electrowins copper from Copper Cliff nickel refinery residue. Annual capacity is a function of copper content in concentrates produced.
Inco Limited Copper Cliff, Ontario	9 000	Electrowinning plant processes copper-bearing fluids.
Falconbridge Limited Timmins, Ontario	145 000	Refines anodes from the Kidd Creek smelter. Incremental expansion increased capacity to 147 000 t/y in 2000.
Total	654 000	
Taseko Mines Limited McLeese Lake, British Columbia	2 000	Dissolved copper-in-solution from heap leaching operations is treated in a solvent extraction plant and then electrowinned to produce copper cathode. Production suspended in December 1998. Operation sold to Taseko Mines Limited in April 1999. Studies under way for 30 000-t/y hydrometallurgical plant.

Source: Data for active facilities were provided by the companies listed in early 2003, and data for Taseko Mines were taken from the 2002 Annual Information Form.

TABLE 7. MONTHLY COPPER PRICES, 2001 AND 2002

	LME Grade A (1)		COMEX HG (2)	
	2001	2002	2001	2002
	(US$/t rounded to nearest $1)			
January	1 768	1 504	1 845	1 538
February	1 766	1 562	1 718	1 513
March	1 739	1 605	1 765	1 643
April	1 664	1 590	1 682	1 612
May	1 682	1 596	1 694	1 544
June	1 608	1 648	1 600	1 680
July	1 525	1 590	1 531	1 595
August	1 464	1 480	1 485	1 495
September	1 426	1 479	1 442	1 422
October	1 377	1 484	1 393	1 440
November	1 428	1 582	1 457	1 448
December	1 472	1 596	1 495	1 596

Source: International Copper Study Group, *ICSG Copper Bulletin*, December 2001, July 2002 and May 2003.
Notes: (1) Settlement price. (2) 1st position.

TABLE 8. YEARLY AVERAGE COPPER PRICES,[1] 1980-2002

	LME
	(current US¢/lb)
1980	2 182.6
1981	1 743.5
1982	1 477.1
1983	1 592.8
1984	1 376.1
1985	1 416.5
1986	1 374.2
1987	1 780.2
1988	2 601.5
1989	2 845.8
1990	2 660.2
1991	2 337.9
1992	2 280.6
1993	1 912.6
1994	2 307.2
1995	2 930.2
1996	2 293.9
1997	2 276.2
1998	1 653.8
1999	1 572.9
2000	1 813.4
2001	1 577.8
2002	1 557.5

Source: International Copper Study Group.
(1) Grade A, Cash.

Diamonds

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Canada continues to emerge as a major player in the world diamond industry. Production increased by over 30% from 3.7 million ct in 2001 to 4.9 million ct in 2002. It is expected that by 2006 Canada will account for about 12% of the world's diamond production and rank third after Botswana and Russia in terms of value of production.

First production from the second Canadian mine, the Diavik diamond mine in the Northwest Territories (N.W.T.), began late in 2002. The mine is a joint venture between Diavik Diamond Mines Inc., a wholly owned subsidiary of RIO Tinto plc of the United Kingdom (60%) and Aber Diamond Corporation of Toronto (40%). The $1.3 billion project is expected to reach full production of around 6 million ct/y by late 2003 or early 2004. Aber has reported that its first sale of rough diamonds sold for an average of US$96/ct, well above the US$62/ct used in the initial mine feasibility study.

The Ekati diamond mine, also in the N.W.T., owned 80% by BHP Billiton and 10% each by Canadians Chuck Fipke and Stewart Blusson, continued to perform very well throughout the year. The company became Canada's first underground diamond mine when ore from the Koala North pipe entered the diamond recovery plant in July 2002. Late in the year, BHP Billiton announced that it had chosen not to renew its three-year rough diamond marketing arrangement with De Beers' Diamond Trading Company.

De Beers' Snap Lake project in the N.W.T. continued through its environmental assessment process being carried out by the Mackenzie Valley Environmental Impact Review Board. Public hearings are expected to be complete by early May 2003 with a final decision to enter the permitting process by the fall.

The Jericho diamond project located in Nunavut and owned by Tahera Corporation is also undergoing environmental assessment. In its case, the assessment is being conducted by the Nunavut Impact Review Board and a decision to enter the permitting process is also expected before the end of 2003.

Companies exploring for diamonds spent about $133 million, which accounted for about 25% of the total expenditures in 2002. This is expected to drop somewhat in 2003 to around $125 million based on companies' early forecasts. Exploration is occurring in most provinces and territories with Alberta, Saskatchewan, Ontario, Quebec, Nunavut and the N.W.T. being the most active locations.

The diamond cutting and polishing industry suffered a minor setback when one of the three plants in Yellowknife was forced to close as a temporary measure. After securing a more senior partner, it is now expected to re-open sometime in the near future. At the same time, Tiffany began construction of a cutting and polishing facility, also located in Yellowknife. Barring any unforeseen circumstances, the company expects to begin producing finished diamonds by mid-year. The plant is designed to employ a maximum of 75 workers. Tiffany has an agreement with Aber to purchase up to US$50 million in rough diamonds annually.

On January 1, 2003, Canada joined with nearly 50 other countries in implementing the Kimberley Process Certification Scheme (KPCS) to control the import and export of rough diamonds. As a relatively new diamond producer, Canada did not have the legislation needed to implement its obligations as a participant in the international KPCS. Canada's Parliament passed the *Export and Import of Rough Diamonds Act* and its associated regulations, which provided the Canadian government with the authority to control all exports and imports of rough diamonds. Under the new legislation, all exports and imports of rough diamonds must be reported to the Minister of Natural Resources Canada, who is the country's export and import authority for rough diamonds.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of February 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

For more information on diamonds in Canada visit: www.nrcan.gc.ca/mms/diam/index_e.htm.

NOTE TO READERS

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TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set	Free	Free	Free	Free
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted, but not mounted or set	Free	Free	Free	Free
7102.29	Diamonds, industrial, other	Free	Free	Free	Free
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted	Free	Free	Free	Free
7102.39	Diamonds, non-industrial, other	Free	Free	Free	Free
7105.10	Natural or synthetic diamond dust or powder	Free	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003.

TABLE 1. CANADA, DIAMOND PRODUCTION AND TRADE, 2000-02

Item No.		2000		2001		2002 (p)	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
PRODUCTION							
	Northwest Territories	2 435 036	624 949	3 716 126	717 780	4 983 953	801 469
EXPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	Belgium	1 810 401	470 752	2 430 813	546 883	3 427 203	594 556
	United Kingdom	706 349	182 747	885 710	207 871	1 546 808	258 292
	United States	800	1 504	317	207	3 666	7 035
	India	–	–	–	–	315	90
	Armenia	–	–	–	–	118	15
	Australia	7	33	–	–	–	–
	Israel	42	71	–	–	–	–
	South Africa	1 863	333	–	–	–	–
	Japan	–	–	3	21	–	–
	Total	2 519 462	655 440	3 316 843	754 982	4 978 110	859 988
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted						
	United States	906	66	2 472	60	17 130	249
7102.29	Diamonds, industrial, other						
	United States	25	134	1 152	174	54 404	249
	United Kingdom	–	–	182	2	6 875	58
	Germany	–	–	–	–	1 748	16
	Japan	–	–	–	–	1 302	12
	Total	25	134	1 334	176	64 329	335
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted						
	United States	10 651	1 520	81	57	1 267	1 668
	Belgium	–	–	–	–	30	33
	Australia	8	4	–	–	7	4
	Israel	41	106	–	–	–	–
	New Zealand	–	–	21	12	–	–
	Total	10 700	1 630	102	69	1 304	1 705
7102.39	Diamonds, non-industrial, other						
	United States	4 806	13 367	7 870	26 109	12 306	42 556
	Belgium	1 076	838	114	728	410	1 233
	Hong Kong	–	–	36	204	73	302
	Japan	–	–	–	–	66	164
	Armenia	–	–	–	–	288	66
	United Kingdom	–	–	–	–	10	20
	South Korea	–	–	–	–	3	3
	South Africa	1 006	179	–	–	6	–
	Israel	304	541	–	–	–	–
	Thailand	49	61	–	–	–	–
	Chile	–	–	18 568	13	–	–
	Total	7 241	14 986	26 588	27 054	13 151	44 323
7105.10	Natural or synthetic diamond dust and powder						
	United States	92 543	80	52 726	50	96 708	103
	Switzerland	–	–	–	–	4 842	7
	South Korea	–	–	–	–	2 200	3
	Hong Kong	476	1	–	–	–	–
	Total	93 019	81	52 726	50	103 750	113
IMPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	Israel	. .	31 690	. .	34 658	3 751	8 729
	India	. .	15 495	. .	13 132	9 015	5 221
	United States	. .	11 927	. .	10 152	5 525	3 663
	Belgium	. .	9 221	. .	7 464	6 071	3 096
	Brazil	–	–	. .	49	54	158
	Switzerland	. .	3	–	–	. .	152
	Other countries	–	3 524	–	3 673	769	303
	Total	. .	71 860	. .	69 128	25 185	21 322

TABLE 1 (cont'd)

Item No.		2000		2001		2002 (p)	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
IMPORTS (cont'd)							
7102.21.00.10	Diamonds, industrial, bort and black, diamonds for borers, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	Ghana	78 472	285	63 789	237	107 343	441
	Belgium	74 336	473	85 754	482	48 119	346
	United States	168 290	663	49 392	245	45 570	180
	United Kingdom	74 656	305	76 896	390	22 084	152
	Botswana	–	–	–	–	17 524	92
	South Africa	8 488	60	10 722	68	5 458	33
	Other countries	19 805	109	9 964	50	26 053	66
	Total	424 047	1 895	296 517	1 472	272 151	1 310
7102.21.00.90	Diamonds, industrial, other, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	United States	73 538	603	78 147	460	60 416	370
	Ghana	7 941	46	25 919	205	56 908	358
	Belgium	13 335	99	8 534	71	20 876	159
	India	–	–	26	–	15 061	114
	Japan	4 785	31	11 387	60	20 515	111
	Other countries	11 399	91	26 538	167	22 435	152
	Total	110 998	870	150 551	963	196 211	1 264
7102.29.00.10	Diamonds, industrial, other, bort and black diamonds, for borers, but not mounted or set						
	United States	1 226	139	2 604	130	42 880	152
	Ghana	2 516	9	–	–	7 919	61
	Australia	110	23	281	58	82	23
	Other countries	499	26	2 038	20	49	12
	Total	4 351	197	4 923	208	50 930	248
7102.29.00.90	Diamonds, industrial, other, other than bort and black, for borers, worked but not mounted or set						
	Belgium	12 091	329	5 321	114	1 226	256
	United States	854	172	3 929	261	1 200	204
	South Africa	13	5	298	25	805	197
	United Kingdom	31	10	232	51	817	168
	Other countries	146 921	1 148	38 785	258	1 438	39
	Total	159 910	1 664	48 565	709	5 486	864
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted, not mounted or set						
	Belgium	4 619	3 285	3 664	3 029	3 303	2 003
	Israel	2 564	1 897	2 641	1 964	2 345	1 481
	India	233	22	1 384	439	675	315
	United States	952	250	1 318	359	460	240
	Botswana	–	–	–	–	486	188
	Namibia	–	–	–	–	376	173
	Australia	–	–	1	1	280	107
	Other countries	885	157	1 100	514	–	–
	Total	9 253	5 611	10 108	6 306	7 925	4 507
7102.39.00.10	Diamonds, non-industrial, other, of a weight not exceeding 0.5 carats each						
	Israel	39 732	35 753	36 614	29 372	41 500	39 851
	Belgium	15 535	14 281	16 079	14 518	24 872	27 168
	United States	15 920	10 732	14 727	9 797	24 389	17 025
	India	7 460	3 368	9 618	3 989	41 107	12 921
	Other countries	1 185	1 445	1 672	1 604	6 236	3 573
	Total	79 832	65 579	78 710	59 280	138 104	100 538

TABLE 1 (cont'd)

Item No.		2000		2001		2002 (p)	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
7102.39.00.20	Diamonds, non-industrial, other, of a weight exceeding 0.5 carats each						
	Israel	48 117	46 769	43 506	37 777	70 133	73 028
	Belgium	80 560	62 022	52 152	46 837	74 212	60 654
	United States	44 930	34 192	37 023	24 174	58 503	43 992
	India	75 912	30 456	73 343	29 267	58 900	30 237
	Other countries	11 027	12 899	8 916	12 652	15 712	18 901
	Total	260 546	186 338	214 940	150 707	277 460	226 812
7105.10.00.10	Diamond dust for borers; dust mixed with a carrier in cartridges or in tubes						
	United States	421 508	1 037	344 258	857	316 876	847
	Ghana	10 842	38	3 900	10	4 473	17
	United Kingdom	3 904	9	1 442	5	777	3
	Other countries	67 526	154	34 478	69	–	–
	Total	503 780	1 238	384 078	941	322 126	867
7105.10.00.91	Natural diamond dust and powder						
	Ireland	7 052	26	193 213	429	685 884	1 214
	United States	150 451	447	143 217	408	115 829	252
	Belgium	20 552	72	11 031	39	5 000	12
	Other countries	4 487	14	7 224	18	3 486	11
	Total	182 542	559	354 685	894	810 199	1 489
7105.10.00.92	Synthetic diamond dust or powder						
	Ireland	1 530 223	3 868	2 329 026	4 579	2 011 213	2 848
	United States	1 225 878	2 416	1 445 256	3 114	2 051 723	2 602
	China	87 314	109	84 013	60	146 954	385
	Belgium	189 673	306	117 575	174	161 329	234
	Other countries	41 325	74	86 159	147	43 189	101
	Total	3 074 413	6 773	4 062 029	8 074	4 414 408	6 170

Sources: Statistics Canada; Natural Resources Canada.
– Nil; . . Not available; (p) Preliminary.

Gold

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2002 mine production:	152 tonnes
World rank:	Eighth
Exports:	$2.7 billion (includes exports from recycled products and public and private reserves)

Canada	2001	2002	2003 (f)
	(000 tonnes)		
Production	160	152	140

(f) Forecast.

Canada has a long tradition as a producer of gold, which was first discovered there in 1823 in the Chaudière River in Quebec. Several more discoveries followed in various rivers in Nova Scotia and British Columbia. The country's gold production was first officially recorded in 1858 at a little over 1 t. The discovery of gold in the Klondike in 1896 quickly drove production to over 40 t by 1900. In 1930, with the opening of gold mines in the Precambrian rocks of Ontario and Quebec, Canada became the second largest gold-producing country in the world, a rank it maintained until 1985 when it was outpaced by the United States and later by Australia. Today, Canada ranks seventh among the producer countries of the world, but Canadian gold companies have branched out all over the world. They are carrying out business in almost 30 countries and are responsible for more than 20% of world gold production. Canadian companies are also active in mineral exploration in over 60 countries. Because of the availability of risk capital, Canadian companies are the most dynamic in the world. They can claim credit for the discovery in recent years of several world-class deposits, including Bulyanhulu in Tanzania, Pierina and Alto Chicama in Peru, Veladero in Argentina, Pascua-Lama in Chile, and Eskay Creek and Red Lake in Canada.

Canada's gold production totalled 152 t in 2002, a [illegible]ase of 5%, or 8 t, compared to 2001. This decline in production is primarily due to closures and the suspension of activities at nine gold mines over the past two years. Production is expected to continue to decrease in 2003 and to remain stable at around 140 t for a number of years. However, once the expansion program at Goldcorp's Red Lake mine is completed, production could rise significantly. Depressed gold prices in recent years have led to significant reductions in exploration expenditures and therefore in the number of discoveries. Over the next five years, Canadian production is expected to remain at the level of 135-145 t/y if no major discoveries are made to compensate for the loss in production of the mines that are forecast to close. Any significant growth in Canadian gold production would have to come from mine capacity expansions or from the resumption of production at existing mines.

In 2002, the average price of gold began what could become a new upward trend lasting for several years. The average price reached US$310/troy oz, which compares with US$271/troy oz in 2001 and US$279/troy oz in 2000. The decline in mining output, the stabilization of gold sales from the official sector, and especially the buyback by mining companies of a portion of their hedging programs led to a price increase that could prove to be sustainable.

ANNUAL AVERAGE SETTLEMENT PRICES, LONDON BULLION MARKET ASSOCIATION

2000	2001	2002	2003
	(US$/troy oz)		
279	271	310	363

(e) Estimated.

The increase in the price of gold also gave gold companies greater access to risk capital, which should translate into greater spending on exploration and the funding of new resources in Canada and abroad where Canadian companies are particularly active.

CANADIAN DEVELOPMENTS

The low price of gold and the depletion of reserves are responsible for the closure of nine mining operations over the past two years. By the end of 2002, there were only about 30 mines remaining in Canada; 10 years earlier, there were more than 50. This decrease in the number of operations is forecast to continue for a few years with 8-10 other mines expected to cease operations by 2005 when their economic reserves are depleted. The lost production resulting from these closures is not expected to exceed 5 t of gold and could be compensated for by the expansion and resumption of production at existing mines. Gold produced in Canada comes primarily from gold mines, which account for 92.5% of the total. The remainder is produced by base-metal (6%) and placer (1.5%) mines. Almost 90% of Canadian gold mines are underground operations where productivity is relatively high, which keeps production costs among the lowest in the world.

For the second consecutive year, Goldcorp Inc. will produce more than 15 t of gold (500 000 oz) at its Red Lake mine at a direct production cost of close to US$65/oz; this will place the mine, for the second year running, among the leading Canadian gold producers for volume of gold produced and among the lowest-cost producers in the world.

In May, Kirkland Lake Gold Inc. (formerly Foxpoint Resources Ltd.) resumed processing operations at the Macassa mill using tailings and ore from surface inventories on the old Teck-Hugues and Lakeshore mining properties. The company is currently installing the equipment and services needed to restart mining activities in the upper levels of the Macassa mine, where it expects to produce about 7000 oz of gold per month early in 2003.

In January 2002, McWatters Mining Inc. (then under the protection of the *Companies' Creditors Arrangement Act* [CCAA]), had its restructuring plan accepted by its creditors and shareholders. Under this plan, the company transferred all of the Sigma-Lamaque property to a limited partnership in which it holds a 60% interest, with Soquem Inc. holding the other 40% interest. The Sigma-Lamaque mine will go into production in early 2003 and will have a production capacity of nearly 150 000 oz/y over six years.

In October, Agnico-Eagle Mines Limited completed work to expand its mill facilities at the LaRonde mine to 7000 t/d. With this expansion, annual gold production will increase to nearly 400 000 oz, a production level that could be reached in 2005. The ore at LaRonde also contains commercial-grade zinc, copper and silver, which will make this mine one of the lowest-cost producers in Canada when the credits obtained for these metals are taken into account.

In the first quarter of 2002, mining activities resumed at the Beaufor mine operated by Richmont Mines Inc. The mine had been closed in August 2000 as a preventive measure due to instability in the mine pillars. Securing the mine and modernizing the Camflo mill, where the ore is processed, required an investment of $5 million.

Campbell Resources Inc. has resumed operations at the Joe Mann mine. The company produced 33 000 oz of gold in 2002 and could produce over 45 000 oz in 2003. It is also mobilizing to restore the Copper Rand property at Chibougamau to production status and mining activities there could start in 2004 or 2005.

Miramar Mining Corporation and Hope Bay Gold Corporation have decided to merge. They each held a 50% interest in the Hope Bay property, which contains a number of high-grade ore deposits. The merger will expedite the start of production on these deposits, which are located in Nunavut, with the first deposit, Doris North, scheduled to go into production in the second half of 2005.

Two mines ceased operations due to ore depletion: McWatters' Kiena mine and Barrick Gold Corporation's Bousquet mine. McWatters carried out an exploration program at Kiena to identify new economic reserves; it is also looking into the possibility of using the mill to process ore from the nearby East-Amphi property.

Placer Dome and Kinross have decided to set up a joint venture to which their respective mining properties in the Porcupine district of Ontario will be transferred. A subsidiary of Placer Dome will manage the new company, which will operate the Hoyle Pond and Dome mines. The combined production will be around 13 or 14 t/y. Placer Dome will hold 51% of the company and Kinross will hold 49%.

WORLD OVERVIEW

The process of consolidation of gold companies that began a few years ago continued at an even greater pace in 2002. Early in the year, Newmont acquired Normandy of Australia. Later, Placer Dome took possession of Aurion Gold, a new corporation that resulted from the merger in 2001 of two Australian companies, Delta Gold and Goldfields. There were also mergers or proposals for mergers between TVX Gold, Kinross Gold and Echo Bay Mining, between Glamis Gold and Francisco Gold, between Repadre Capital and IAMGold, between Meridian and Brancote Holdings, and between Bema Gold and EAGC Ventures Corp.

Despite all these mergers and acquisitions, the gold sector remains relatively unconcentrated at the company level. Over the past five years, the proportion of gold production from the 10 largest producers increased from 47% in 1998 to about 55% in 2002, and is expected to rise to almost 60% in 2003. The increase in the value of shares in gold companies that followed the increase in the price of gold will favour mergers over acquisitions because of the excessive costs involved in purchasing a gold mining company.

After setting a new record in terms of quantity produced in 2001, global gold mine production began a slight decline that could last for a few years. This drop in production, combined with the buyback of a portion of the mining companies' hedging programs, are the main causes of the increase in the price of gold in 2002. Mine production totalled 2587 t, a reduction of 36 t compared to the previous year's record quantity. This production record was set despite several years of depressed prices, illustrating the inelastic behaviour of this element of the gold supply. However, the supply's inelasticity will probably delay the growth of mine production, which can be expected to keep prices high for a while. Mine production, gold sales and loans by central banks, recycled gold, and sales by investors resulted in a global gold supply that reached nearly 3980 t, a slight increase over the previous year. The main explanation for this increase was an 18% rise in the amount of recycled gold in response to higher prices.

Demand for gold, mainly from jewellery, electronics and investment sectors, rose slightly in 2002. The significant increase in the price of gold substantially reduced demand from the jewellery sector. This major decrease was offset by the buyback by mining companies of a portion of their hedging programs, which maintained the price of gold at higher levels than had been forecast for 2002. Buyback activities are expected to continue in 2003, although on a more limited scale.

In 2002, China continued its policy of liberalizing the gold sector in its territory. It now intends to authorize direct participation by foreign corporations in gold mining and has inaugurated a new exchange in Shanghai where gold will be traded freely, ending 50 years of absolute government control over the price of gold. This liberalizing policy could result in a doubling of China's gold use to more than 400 t/y.

Barrick Gold Corporation has discovered a major deposit on its Alto Chicama property in Peru. The results of initial exploration work indicate gold resources of over 6.5 million oz. The similarities between this deposit and the Pierina deposit, located 175 km from the discovery, already promise a mine with very low production costs. Barrick is confident that it can expand these resources even further and expects to devote nearly US$35 million in exploration expenditures to this purpose. The property could be brought into production by 2005 at an initial production capacity of 500 000 oz/y.

MARKET SITUATION

World mine production, which has been rising for nearly 20 years, began to decline in 2002, thus entering a downward cycle that could last three or four years. The weakness in the price of gold in recent years has led to a significant drop in exploration expenditures, which in turn has lowered the number of economic deposits discovered. The decline in gold production as a result of mine closures cannot be completely offset by mine expansion or by the start-up of production at new deposits in the short term. Until 2004 when the *Washington Agreement* expires, gold sales and loans by central banks – another important element in the gold supply – are expected to remain more or less at the same level as in the past two years. It is highly likely that the central European banks will renew the *Washington Agreement*; however, if the price of gold remains above US$350/oz, they could increase their gold sales by an additional 100-200 t/y, thus raising their sales to over 500 t/y.

World demand grew more than 35% over the last decade, mainly because weakness in the price of gold led to an increase in demand by jewellers that specialize in gold jewellery. Barring too large and too rapid an increase in the price of gold, in which case investors would become the component of demand most likely to cause an increase or decrease in the price, world gold demand for jewellery and electronics is expected to resume its upward trend as soon as favourable economic conditions are restored. *Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of November 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.*

NOTE TO READERS

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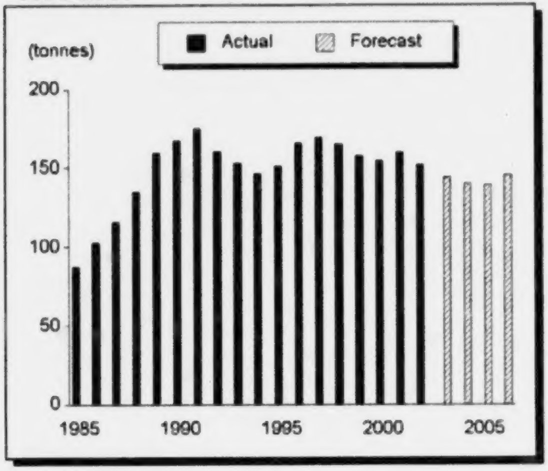
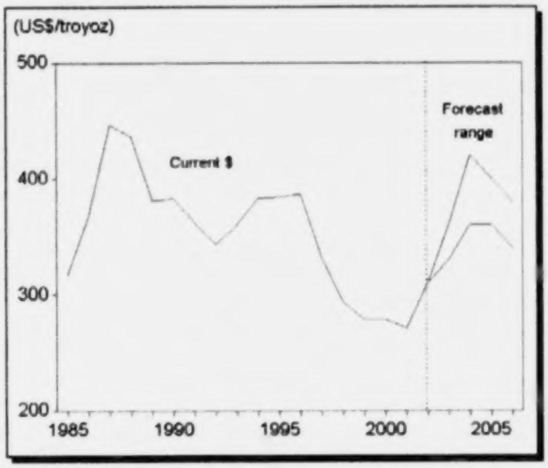
Figure 1
Mine Production of Gold in Canada, 1985-2006



Source: Natural Resources Canada.

Figure 2
London Bullion Market Association Gold Prices, 1985-2006



Source: Natural Resources Canada.

TABLE 1. CANADA, GOLD PRODUCTION AND TRADE, 2000-2002

		2000		2001		2002 (p)	
		(grams)	($000)	(grams)	($000)	(grams)	($000)
PRODUCTION							
	Newfoundland and Labrador	1 454 798	19 353	1 503 224	20 203	1 476 946	22 897
	Prince Edward Island	–	–	–	–	–	–
	Nova Scotia	–	–	(r) 45 038	(r) 605	–	–
	New Brunswick	236 464	3 146	262 382	3 526	246 491	3 821
	Quebec	34 498 621	458 935	33 995 945	456 906	32 620 000	505 708
	Ontario	71 851 355	955 839	79 859 887	1 073 317	76 150 811	1 180 566
	Manitoba	7 144 016	95 037	6 424 801	86 349	5 389 873	83 559
	Saskatchewan	1 863 338	24 788	1 898 121	25 511	1 466 986	22 743
	Alberta	21 981	292	38 705	520	38 705	600
	British Columbia	25 129 245	334 294	23 614 119	317 374	21 703 229	336 465
	Yukon	3 980 686	52 955	2 775 158	37 298	2 018 684	31 296
	Northwest Territories	(r) 3 838 558	(r) 51 064	4 041 240	54 314	3 382 476	52 439
	Nunavut	3 695 820	49 165	4 415 978	59 351	3 372 019	52 276
	Total	(r) 153 714 881	(r) 2 044 869	158 874 598	2 135 275	147 866 220	2 292 370
	Mine output	(r) 155 538 034	. .	160 199 710	. .	152 191 395	. .
EXPORTS							
2600.00 (1)	Gold in ores and concentrates	4 428 479	30 293	3 967 812	16 272	3 242 805	41 842
7 108.11	Gold powder						
	United States	6 147 608	81 462	9 087 177	124 231	4 390 801	65 556
	Japan	–	–	–	–	195	3
	Total	6 147 608	81 462	9 087 177	124 231	4 390 996	65 559
7 108.12	Other unwrought forms						
	United States	146 083 265	2 001 369	125 869 886	1 728 791	144 668 723	2 310 469
	United Kingdom	88 403	781	13 012 008	174 543	7 691 486	115 769
	Japan	2 488 280	32 810	502 656	6 690	1 987 420	30 298
	United Arab Emirates	–	–	713 300	9 364	997 742	14 684
	Switzerland	20 543 683	44 867	2 527 892	35 230	43 873	665
	Other countries	1 200 950	16 315	597 187	10 828	10 400	156
	Total	170 404 581	2 096 142	143 222 929	1 965 446	155 399 644	2 472 041

TABLE 1 (cont'd)

		2000		2001		2002 (p)	
		(grams)	($000)	(grams)	($000)	(grams)	($000)
7 108.13	Other semi-manufactured forms						
	United States	26 021 294	335 053	9 476 313	112 542	10 502 104	127 216
	Other countries	3 328	88	–	–	215	4
	Total	26 024 622	335 141	9 476 313	112 542	10 502 319	127 220
	Total refined gold exports	207 005 290	2 543 038	165 754 231	2 218 491	173 535 764	2 706 662
IMPORTS (2)							
2600.00 (3)	Gold in ores and concentrates	6 042 305	68 379	7 664 948	93 198	4 102 965	50 292
7108.11	Gold powder						
	United States	60 529	763	45 741	534	27 371	355
	Italy	1 398	22	2 127	17	501	10
	Other countries	157 284	1 932	1 303	17	57	. . .
	Total	219 211	2 717	49 171	568	27 929	365
7108.12	Other unwrought forms						
	Guyana	13 144 590	184 419	13 679 561	195 187	13 916 180	218 304
	Japan	14 086	100	183	2	9 957 629	156 143
	United States	19 398 673	252 817	13 314 775	121 440	5 955 147	74 543
	Suriname	4 805 918	54 388	4 018 370	47 618	2 831 312	37 592
	Nicaragua	3 268 538	31 531	3 013 280	28 039	2 588 467	26 347
	South Korea	–	–	–	–	911 000	15 560
	Switzerland	10 964	170	222 263	3 082	304 410	4 768
	Jamaica	–	–	115 649	1 055	249 432	1 849
	United Kingdom	695 061	9 114	778	10	90 754	1 282
	Other countries	992 243	12 410	3 515 071	30 777	198 207	2 524
	Total	42 330 073	544 949	37 879 930	427 210	37 002 538	538 912
7108.13	Other semi-manufactured forms						
	United States	(r) 924 097	(r) 11 965	946 783	11 369	637 126	8 827
	Singapore	–	–	34 467	600	150 907	2 832
	South Africa	–	–	–	–	214 791	2 031
	Switzerland	117 594	1 741	119 582	1 858	121 129	1 914
	Other countries	395 681	3 645	35 756	535	40 565	591
	Total	(r) 1 437 372	(r) 17 351	1 136 586	14 362	1 164 518	16 195
	Total refined gold imports	(r) 50 028 961	(r) 633 396	46 730 637	535 338	42 297 950	605 764

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; (p) Preliminary; (r) Revised.
(1) Includes HS classes 2603.00.82, 2607.00.82, 2608.00.82, 2616.10.82 and 2616.90.82. (2) Imports from "Other countries" may include re-imports from Canada. (3) Includes HS classes 2603.00.00.82, 2604.00.00.82, 2607.00.00.82, 2608.00.00.82, 2616.10.00.82 and 2616.90.00.20.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, GOLD PRODUCTION BY SOURCE, 1975, 1980 AND 1985-2002

	Auriferrous Quartz Mines		Placer Operations		Base-Metal Ores		Total	
	(kg)	(%)	(kg)	(%)	(kg)	(%)	(kg)	(%)
1975	37 530	73.0	335	0.6	13 569	26.4	51 433	100.0
1980	31 929	63.1	2 060	4.0	16 632	32.9	50 620	100.0
1985	67 241	76.8	3 464	4.0	16 857	19.2	87 562	100.0
1986	83 197	80.9	2 802	2.7	16 900	16.4	102 899	100.0
1987	94 723	81.8	4 009	3.5	17 086	14.8	115 818	100.0
1988	112 404	83.4	4 879	3.6	17 530	13.0	134 813	100.0
1989	138 211	86.6	5 354	3.4	15 930	10.0	159 494	100.0
1990	147 355	88.0	3 993	2.4	16 025	9.6	167 373	100.0
1991	153 859	87.8	3 834	2.2	17 589	10.0	175 282	100.0
1992	141 965	88.5	3 469	2.2	14 917	9.3	160 351	100.0
1993	137 346	89.7	3 787	2.5	11 997	7.8	153 129	100.0
1994	133 018	90.8	3 714	2.5	9 696	6.6	146 428	100.0
1995	132 834	88.0	5 303	3.5	12 730	8.4	150 867	100.0
1996	147 052	89.3	3 971	2.4	13 636	8.3	164 660	100.0
1997	155 543	90.7	3 987	2.3	11 949	7.0	171 479	100.0
1998	142 846	86.7	3 098	1.9	18 829	11.4	164 773	100.0
1999	141 467	89.7	3 081	2.0	13 068	8.3	157 617	100.0
2000	(r) 139 145	(r) 90.5	2 695	(r) 1.8	11 874	7.7	(r) 153 715	100.0
2001	144 815	91.2	2 461	1.5	11 598	7.3	158 875	100.0
2002	140 838	92.7	2 347	1.6	8 719	5.7	151 904	100.0

Source: Natural Resources Canada.
(r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 3. WORLD MINE PRODUCTION OF GOLD, 1993-2002

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
					(tonnes)					
NORTH AMERICA										
Canada (1)	153	146	151	165	172	165	158	154	159	148
United States	332	326	319	329	359	364	342	355	334	299
Total North America	485	472	470	494	531	529	500	509	493	447
AFRICA										
South Africa	620	584	522	495	493	464	450	428	394	395
Ghana	41	45	53	50	56	73	78	74	72	70
Mali	6	6	8	7	18	23	25	30	45	56
Tanzania	8	7	5	6	5	6	9	17	34	39
Zimbabwe	21	23	26	27	26	27	30	25	22	20
Guinea	4	4	7	7	7	12	13	16	17	17
Other Africa	31	35	33	33	33	29	29	29	32	34
Total Africa	731	703	655	624	638	634	634	621	615	631
LATIN AMERICA										
Peru	27	39	57	65	75	92	129	133	134	157
Brazil	76	73	67	64	59	55	54	53	51	46
Chile	39	43	49	56	53	48	48	50	40	35
Argentina	1	1	1	1	3	20	35	26	31	33
Mexico	11	14	20	25	26	26	24	27	26	23
Colombia	26	26	24	23	22	22	21	21	20	20
Venezuela	11	14	17	20	20	14	12	14	17	17
Bolivia	12	15	16	15	16	17	15	15	16	14
Guyana	10	12	9	11	14	15	13	14	14	14
Other	19	19	26	28	29	30	29	26	28	27
Total Latin America	233	256	286	308	316	339	381	378	376	386
ASIA										
Indonesia	52	55	74	93	102	139	152	140	183	158
Papua New Guinea	62	61	55	54	49	63	65	76	68	65
Philippines	30	31	29	32	34	35	33	35	32	33
Japan	9	10	9	9	8	9	9	8	8	9
Other	19	19	21	21	21	18	17	17	19	26
Total Asia	172	176	188	208	214	264	276	276	310	291
EUROPE	25	27	28	29	27	27	24	20	20	21
OCEANIA										
Australia	247	255	255	290	313	310	300	296	285	264
Other	15	15	14	16	16	16	16	15	14	13
Total Oceania	262	270	269	306	329	326	316	312	299	277
Total Western World	1 908	1 903	1 895	1 968	2 058	2 117	2 131	2 116	2 112	2 054
OTHER COUNTRIES										
China	119	123	148	159	163	165	163	172	193	202
Russia	165	158	142	133	138	127	138	154	165	181
Uzbekistan	65	65	67	78	82	80	88	88	85	87
Kyrgyzstan	1	2	2	4	17	21	20	22	25	18
Kazakhstan	14	15	15	12	11	9	10	13	15	14
Tadjikistan	1	2	2	2	3	3	3	4	4	4
C.I.S., other	1	2	2	2	2	3	3	4	5	7
Mongolia	1	2	4	6	10	9	11	13	14	14
North Korea	15	14	14	12	9	7	7	7	7	7
Total other countries	383	382	396	407	434	425	443	476	512	533
Total world production	2 291	2 285	2 291	2 375	2 493	2 542	2 574	2 591	2 623	2 587

Source: Gold Fields Mineral Services Ltd "Gold Survey 2003."

(1) Production figures for Canada were obtained from Natural Resources Canada.

Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, GOLD PRODUCTION, AVERAGE VALUE AND PERCENT OF TOTAL MINERAL PRODUCTION, 1975, 1980 AND 1985-2002

Year	Total Production	Total Value	Average Value (1)	Gold as a Percent of Total Mineral Production
	(kg)	($000)	($/g)	(%)
1975	51 433	270 830	5.27	2.00
1980	50 620	1 165 416	23.02	3.70
1985	87 562	1 219 653	13.93	2.70
1986	102 899	1 689 292	16.42	5.20
1987	115 818	2 204 472	19.03	6.10
1988	134 813	2 331 989	17.30	6.30
1989	159 494	2 315 860	14.52	5.90
1990	167 373	2 407 654	14.38	5.90
1991	175 282	2 338 614	13.34	6.70
1992	160 351	2 141 161	13.35	6.00
1993	153 129	2 284 991	14.92	6.20
1994	146 428	2 448 926	16.86	6.00
1995	150 867	2 557 502	16.95	5.90
1996	164 660	2 799 547	17.00	5.60
1997	171 479	2 527 429	14.74	5.00
1998	164 773	2 312 593	14.04	5.20
1999	157 617	2 099 302	13.32	3.90
2000	(r) 153 715	(r) 2 044 869	13.30	2.40
2001	158 875	2 135 275	13.44	2.60
2002	151 904	2 377 303	15.65	(p) 3.09

Source: Natural Resources Canada.
(p) Preliminary; (r) Revised.
(1) Value is based on average London p.m. fix price for gold.

TABLE 5. GOLD FABRICATION IN DEVELOPED AND DEVELOPING COUNTRIES, 1993-2002

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
					(tonnes)					
DEVELOPED COUNTRIES										
Carat jewellery	1 188	1 168	1 147	1 105	1 159	1 147	1 132	1 126	1 043	926
Electronics	151	162	180	185	208	200	221	258	181	188
Dentistry	56	58	62	63	66	60	61	65	64	65
Other uses	71	73	77	77	76	68	62	60	55	49
Medals and fake coins	5	5	3	2	3	2	4	2	3	2
Official coins	100	58	70	48	83	110	116	30	39	50
Subtotal	1 571	1 524	1 538	1 479	1 594	1 587	1 595	1 540	1 384	1280
DEVELOPING COUNTRIES										
Carat jewellery	1 371	1 473	1 665	1 751	2 153	2 034	2 022	2 106	2 000	1 763
Electronics	27	25	24	23	26	26	26	27	23	22
Dentistry	7	6	5	5	5	4	5	5	4	5
Other uses	29	31	33	35	39	35	37	41	46	33
Medals and fake coins	23	23	31	32	41	45	43	55	52	53
Official coins	22	14	17	16	16	17	18	18	17	19
Subtotal	1 479	1 572	1 776	1 862	2 280	2 162	2 150	2 252	2 137	1 895
TOTAL										
Carat jewellery	2 559	2 641	2 812	2 856	3 312	3 181	3 154	3 232	3 043	2 689
Electronics	178	187	204	208	234	226	247	285	204	210
Dentistry	63	64	67	68	71	64	66	70	68	70
Other uses	100	104	110	112	115	103	99	101	101	82
Medals and fake coins	28	28	34	34	44	47	47	57	55	55
Official coins	122	72	87	64	99	127	134	48	56	69
Total gold fabrication	3 050	3 096	3 314	3 341	3 873	3 749	3 745	3 792	3 522	3 175

Source: Gold Fields Mineral Services Ltd., "Gold Survey 2003."
Note: Numbers may not add to totals due to rounding.

TABLE 6. AVERAGE ANNUAL GOLD PRICES, 1934-2002, AND MONTHLY, 1998-2002

Year	US$/oz	C$/oz	Year	US$/oz	C$/oz
1934-67	35.00	. .	1985	317.35	433.21
1968	38.82	41.82	1986	367.58	510.73
1969	41.13	44.29	1987	446.66	592.18
1970	35.97	37.54	1988	436.45	554.76
1971	40.87	41.27	1989	381.27	451.33
1972	58.22	57.66	1990	383.72	447.79
1973	97.22	97.24	1991	362.34	415.09
1974	158.80	155.36	1992	343.86	415.23
1975	160.96	163.76	1993	360.06	464.35
1976	124.78	123.01	1994	384.15	524.60
1977	147.80	157.10	1995	384.07	526.94
1978	193.51	220.74	1996	387.69	528.62
1979	305.69	358.12	1997	328.41	454.52
1980	614.38	719.08	1998	294.11	435.77
1981	459.22	550.57	1999	278.86	413.57
1982	375.52	463.51	2000	279.11	414.70
1983	423.52	521.82	2001	271.40	403.08
1984	360.63	466.99	2002	309.73	486.40

Month	1998		1999		2000		2001		2002	
	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)
January	289.26	416.53	287.31	436.48	284.32	411.95	265.49	399.06	281.65	450.73
February	297.74	425.77	287.5	430.47	299.94	435.24	261.86	398.50	295.50	471.56
March	295.87	420.14	286.24	434.37	286.39	418.30	263.03	409.91	294.05	466.66
April	308.56	441.24	282.62	417.83	279.86	410.95	260.48	405.70	302.68	478.66
May	298.95	430.49	276.93	404.87	275.31	411.73	272.35	419.83	314.49	487.37
June	292.22	426.64	261.40	384.02	285.73	421.97	270.23	411.94	321.18	491.95
July	292.89	436.41	256.20	381.43	281.55	416.10	267.53	409.43	313.29	484.31
August	284.23	434.87	256.94	383.43	274.47	406.89	272.39	419.54	310.25	486.44
September	288.67	438.78	264.47	390.57	273.68	406.73	283.42	444.32	319.16	502.93
October	296.48	456.58	311.56	460.27	270.00	408.32	293.06	460.46	316.56	499.47
November	294.24	453.13	293.65	430.93	266.01	410.24	276.16	439.76	319.15	501.51
December	291.34	448.66	283.74	418.03	271.45	413.26	275.85	435.15	332.43	518.36

Source: London Bullion Market Association, p.m. fix.
. . Not available.

Gypsum and Anhydrite

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GYPSUM

Canadian shipments of natural gypsum totaled 8.8 Mt valued at $112.7 million in 2002, based on preliminary data (Table 1). This amount compares to 7.8 Mt valued at $96.0 million in 2001, based on final data. The reported 13% increase in shipments resulted mainly from increased construction activity in Canada, based on preliminary data from Statistics Canada and the Gypsum Association. In addition to shipments of natural gypsum in 2002, domestic shipments of commercial-quality, synthetic, flue-gas desulphurization (FGD) gypsum from coal-fired generating stations are estimated to be about 350 000 t/y. Total use of FGD gypsum in Canada, including imports, is estimated to be about 500 000 t/y.

Canadian Industry

Most producers of natural gypsum in Canada are closely integrated in both mining and wallboard manufacturing. Five major companies operate a total of 10 mines and 13 wallboard plants accounting for an estimated 1900 employees. The major gypsum mining and related production plants are listed in Table 2. In addition, two companies produce FGD gypsum for the manufacture of wallboard in Canada. These are: 1) Ontario Power Generation Inc. (OPG), which sells its product to Westroc Inc., located near Toronto, Ontario; and 2) NB Power (Belledune Generating Station) in New Brunswick, which sells its product to CGC Inc. in Montréal, Quebec. (Both OPG and NB Power use the wet limestone system for recovering FGD gypsum.)

In Atlantic Canada, Nova Scotia accounts for about 83% of Canada's output of natural gypsum and nearly all of its exports. Most gypsum deposits being mined in the Atlantic provinces are characterized by their high quality, amenability to inexpensive mining methods, and close access to coastal bulk-shipping facilities.

Galen Gypsum Mines Limited in St. George's, Newfoundland and Labrador, has been reactivated and supplied gypsum to Lafarge Gypsum Canada Inc. in Corner Brook.

Georgia-Pacific Corporation, operating in Nova Scotia, plans to close its mine at Sugar Camp, Cape Breton Island, and phase in a new mine in 2003 in the same area near Melford.

In Quebec, most demand for gypsum is satisfied by shipments of raw material, including synthetic gypsum, from Atlantic Canada.

In Ontario and in western Canada there were no new developments reported.

World Developments and Trade

Natural gypsum is by far the most important source of raw material for this mineral's many uses. However, synthetic gypsum produced mainly by the FGD process accounts for 3-5% of the total combined output of crude and commercial-quality synthetic gypsum produced in Canada.

Stricter environmental regulations worldwide have acted as a driver to reduce sulphur dioxide regulations in many countries. In the United States, of 19 newly built plants or expansions since 1998, nearly all use synthetic (mainly FGD) gypsum. The production of synthetic gypsum in the United States is estimated to be 7.7 Mt, accounting for about one third of the combined output of crude and synthetic gypsum, which totals 23.8 Mt. This amount represents about 24% of total apparent use, which in turn represents more than a twofold increase during the five-year period from 1998 to 2002, according to the U.S. Geological Survey (USGS).

World production of gypsum in 2002 is an estimated 103 Mt, based mainly on USGS sources (Office of Minerals Information's web site at www.usgs.gov). The United States ranked number one with production of 16.1 Mt, followed by Iran, 11.0 Mt; Canada, 8.9 Mt; Spain, 7.5 Mt; and Mexico, 6.3 Mt.

Canada's imports of gypsum from the United States and Mexico (Table 1) are used by both wallboard and cement manufacturers. Imports from Spain, however, are believed to be entirely non-calcined material for use by some cement producers.

In the United States, the construction of several major new plants and expansions designed to use only synthetic gypsum continued during 2002.

Processing and Markets

The gypsum wallboard industry mainly serves the residential, institutional and commercial building sectors. In North America, wallboard manufacturing accounts for an estimated 75% of gypsum use, cement processing accounts for 10-15%, and agriculture and industrial processes account for the remainder of uses.

Canadian wallboard plants in 2002 shipped about 305 million m^2 (3.28 billion square feet) of finished products compared to about 294 million m^2 in 2001, according to Statistics Canada. (This amount represents an increase of about 4% compared to the previous 12-month period.)

Shipments of wallboard by U.S. producers in 2002 were 2.77 billion m^2 (29.87 billion square feet), according to the Gypsum Association.

The Portland cement industry requires crushed, non-calcined gypsum acting as a set regulator in a proportion up to 5% by total weight. This mineral is ground with the primary stage clinker to produce a secondary stage cement powder for use mainly in concrete products. Based on this proportion of gypsum, the total amount of gypsum required by cement producers in Canada is estimated to be 500 000-550 000 t/y.

Other uses for gypsum relate mainly to agriculture as a soil conditioner and as a mineral filler in joint compounds, plastics and paints, and in certain glass-making technologies.

A portion of the gypsum waste generated annually by wallboard manufacturing, installation and demolition is recycled. Although data are not available, it is estimated that 100 000-200 000 t/y of gypsum are recycled; this amount would represent 5-10% of the gypsum used for making wallboard in Canada.

Process Research ORTECH Inc. sponsored Gypsum and Fly Ash 2002 – 7th International Science and Technology Conference and Short Course, which was held in Toronto in June 2002. This series of conferences has contributed greatly to improving communication and the dissemination of new information among power utilities and other synthetic gypsum producers, users and equipment suppliers. Also, with renewed interest in the importance of fly ash as a major coal combustion product (CCP) used as a supplementary cementing material (SCM) to partially replace energy-intensive Portland cement, this conference attracted a wide range of delegates. (The use of CCPs in Canada is highlighted in a separate commodity chapter entitled *Cement* – refer to Table 4.)

Prices

Prices for gypsum in merchant markets are negotiated among buyers and sellers, and published figures are not always relevant. In Canada, the average reported value for crude gypsum, f.o.b. mine, is about $12/t for the five-year period from 1998 to 2002.

Outlook

Canadian shipments of gypsum in 2003 are expected to be lower, mainly based on weaker exports to the United States. However, housing starts in Canada are expected to remain firm. Housing starts were about 205 000 in 2002, according to the Canada Mortgage and Housing Corporation. By way of comparison, starts were about 152 000 in 2000 and 163 000 in 2001. (Additional information relating to residential construction can be obtained on the Internet at www.cmhc-schl.gc.ca.) Non-residential construction, mainly based on gains in institutional building permits, is expected to be greater in 2003.

Diverse uses of gypsum related to building plasters, Portland cement, fillers and pigments, soil conditioners, and fertilizers as a diluent are important and tend to expand with overall economic growth. The present structure of the industry in Canada is not expected to change significantly, although the future availability of low-cost synthetic gypsum resulting from more strenuous emission controls may serve to increase demand for this mineral.

Based on a recent study, FGD systems to capture sulphur dioxide from power plant stacks may double by 2006. In addition, it has been stated that limestone wet scrubbing with a gypsum by-product will continue to be the leading desulphurization technology used on all continents. However, lime-based systems and ammonia scrubbers will also be important (www.mcilvainecompany.com).

ANHYDRITE

Production and trade statistics for anhydrite are included with gypsum. Anhydrite, the anhydrous form of gypsum (about twice as hard and also denser than gypsum), is produced by Fundy Gypsum Company at Wentworth, Nova Scotia, and by Little Narrows Gypsum Company at Little Narrows, Nova Scotia.

Shipments of anhydrite in 2001 were about 125 000 t, mainly to the United States for use as a peanut crop fertilizer, and to Quebec and Ontario for final-stage processing of Portland cement. Similarly, shipments in 2002 were an estimated 130 000 t, according to the Nova Scotia Department of Natural Resources.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 30, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

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TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2520.10	Gypsum; anhydrite	Free	Free	Free	Free
2520.20	Plasters	Free	Free	Free	Free
68.09	Articles of plaster or of compositions based on plaster;				
	Boards, sheets, panels, tiles and similar articles, not ornamented				
6809.11	Faced or reinforced with paper or paperboard only				
6809.11.10	Gypsum wallboard	6%	Free	Free	Free
6809.11.90	Other	6%	Free	Free	Free
6809.19.00	Other	6.5%	3%	Free	Free
6809.90	Other articles				
6809.90.10	Models and casts, of a kind used in the manufacture of dental prostheses	Free	Free	Free	Free
6809.90.90	Other	6.5%	3%	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003.

TABLE 1. CANADA, GYPSUM PRODUCTION AND TRADE, 2000-02

Item No.		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (shipments)							
	Crude gypsum						
	Newfoundland and Labrador	x	x	x	x	–	–
	Nova Scotia	6 953 440	81 337	6 397 057	75 468	7 361 326	86 936
	Ontario	x	x	x	x	x	x
	Manitoba	x	x	x	x	x	x
	British Columbia	x	x	x	x	x	x
	Total (1)	8 572 464	105 655	7 821 013	95 965	8 905 978	113 285
IMPORTS							
2520.10	Gypsum, anhydrite						
	United States	78 882	10 240	155 897	12 232	257 394	14 012
	Mexico	75 673	1 763	87 204	1 424	75 015	1 078
	Other countries	49	42	59	19	50	32
	Total	154 604	12 045	243 160	13 675	332 459	15 122
2520.20	Gypsum; anhydrite; plasters						
	United States	36 194	11 197	36 916	11 958	60 039	14 610
	Italy	(r) 131	82	68	49	226	100
	Germany	51	46	76	70	78	77
	Japan	122	106	256	168	77	43
	United Kingdom	34	11	34	16	87	24
	France	9	1	2	. . .	20	12
	Other countries	171	56	218	143	76	17
	Total	(r) 36 712	11 499	37 570	12 404	60 603	14 883
		(n.a.)	**($000)**	**(n.a.)**	**($000)**	**(n.a.)**	**($000)**
6809.11	Plasterboards, etc., not ornamental; faced or reinforced with paper or paperboard						
	United States	n.a.	7 475	n.a.	15 487	n.a.	31 386
	France	–	–	n.a.	1	n.a.	51
	United Kingdom	n.a.	35	n.a.	83	n.a.	38
	Other countries	n.a.	61	n.a.	184	n.a.	69
	Total	n.a.	7 571	n.a.	15 755	n.a.	31 544
6809.19	Plasterboards, etc., not ornamental; faced or reinforced, n.e.s.						
	United States	n.a.	10 822	n.a.	13 275	n.a.	15 273
	Mexico	n.a.	. . .	n.a.	134	n.a.	378
	France	n.a.	. . .	n.a.	59	n.a.	107
	China	n.a.	29	n.a.	34	n.a.	45
	Other countries	n.a.	21	n.a.	18	n.a.	55
	Total	n.a.	10 872	n.a.	13 520	n.a.	15 858
6809.90	Articles of plaster or compositions based on plaster						
	United States	n.a.	(r) 3 527	n.a.	2 010	n.a.	2 853
	United Kingdom	n.a.	507	n.a.	245	n.a.	2 035
	Mexico	n.a.	1 531	n.a.	2 639	n.a.	935
	China	n.a.	(r) 1 058	n.a.	1 109	n.a.	540
	Thailand	n.a.	18	n.a.	53	n.a.	364
	France	n.a.	3	n.a.	16	n.a.	94
	Other countries	n.a.	126	n.a.	127	n.a.	149
	Total	n.a.	(r) 6 770	n.a.	6 199	n.a.	6 970
	Total imports of gypsum and gypsum products	n.a.	(r) 48 757	n.a.	61 553	n.a.	84 377
		(tonnes)	**($000)**	**(tonnes)**	**($000)**	**(tonnes)**	**($000)**
EXPORTS							
2520.10	Gypsum, anhydrite						
	United States	6 318 451	97 430	5 596 557	83 356	5 244 145	68 184
	Czech Republic	–	–	–	–	832	56
	Latvia	–	–	–	–	457	42
	Hong Kong	–	–	–	–	144	10
	Other countries	235	14	–	–	82	6
	Total	6 318 686	97 444	5 596 557	83 356	5 245 660	68 298

TABLE 1 (cont'd)

Item No.		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
2520.20	Gypsum; anhydrite; plasters						
	United States	765	651	2 118	1 897	4 488	2 530
	Ireland	–	–	–	–	125	70
	China	–	–	21	55	12	7
	Cuba	–	–	79	119	4	3
	Other countries	242	157	48	29	118	100
	Total	1 007	808	2 266	2 100	4 747	2 710
		(square metres)		**(square metres)**		**(square metres)**	
6810.11	Plasterboards, etc., not ornamental; faced or reinforced with paper or paperboard						
	United States	73 254 228	129 152	72 511 762	82 971	51 542 296	61 384
	Saint Kitts and Nevis	–	–	29 680	74	134 238	374
	France	–	–	590	16	21 795	52
	Cuba	14 017	35	24 040	87	6 767	26
	Saint Pierre and Miquelon	8 767	6	7 949	26	8 848	22
	Dominican Republic	–	–	–	–	19 587	21
	Bermuda	10 300	26	13 180	33	7 600	19
	Trinidad and Tobago	32 658	81	5 308	16	25 000	16
	Saint Vincent and the Grenadines	–	–	–	–	870	3
	Chile	513	4	–	–	–	–
	China	17 200	43	–	–	–	–
	Croatia	5 400	14	–	–	–	–
	Germany	14 900	37	–	–	–	–
	Hong Kong	26 042	50	–	–	–	–
	Hungary	12 122	47	–	–	–	–
	India	4 950	12	–	–	–	–
	Latvia	4 672	8	7 031	32	–	–
	Portugal	19 000	48	–	–	–	–
	Saudi Arabia	26 155	65	–	–	–	–
	Argentina	–	–	3 329	8	–	–
	Japan	–	–	440	3	–	–
	Taiwan	–	–	6 907	21	–	–
	Total	73 450 924	129 628	72 610 216	83 287	51 767 001	61 917
		(n.a.)	**($000)**	**(n.a.)**	**($000)**	**(n.a.)**	**($000)**
6809.19	Plasterboards, etc., not ornamental; faced or reinforced, n.e.s.						
	United States	n.a.	28 110	n.a.	29 694	n.a.	27 689
	Switzerland	–	–	–	–	n.a.	157
	United Arab Emirates	–	–	–	–	n.a.	135
	Fiji	–	–	–	–	n.a.	83
	Other countries	n.a.	488	n.a.	832	n.a.	96
	Total	n.a.	28 598	n.a.	30 526	n.a.	28 160
6809.90	Articles of plaster or compositions based on plaster						
	United States	n.a.	29 759	n.a.	35 570	n.a.	37 955
	Finland	n.a.	123	n.a.	56	n.a.	451
	Hong Kong	–	–	–	–	n.a.	243
	Singapore	–	–	–	–	n.a.	136
	United Arab Emirates	n.a.	22	–	–	n.a.	117
	Bermuda	n.a.	21	n.a.	50	n.a.	92
	Other countries	n.a.	177	n.a.	197	n.a.	268
	Total	n.a.	30 102	n.a.	35 873	n.a.	39 262
	Total exports of gypsum and gypsum products	n.a.	286 580	n.a.	235 142	n.a.	200 347

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable; n.e.s. Not elsewhere specified; (p) Preliminary (r) Revised; x Confidential.
(1) Totals do not include gypsum produced or shipped for use by Canadian Portland cement producers.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, GYPSUM MINING AND GYPSUM PRODUCTS MANUFACTURING OPERATIONS, 2002

Company	Location	Operation
NEWFOUNDLAND AND LABRADOR		
Galen Gypsum Mines Limited	Coal Brook	Open-pit mining
Lafarge Gypsum Canada Inc.	Corner Brook	Wallboard manufacture
NOVA SCOTIA		
CGC Inc.	Port Hawkesbury	Fibre-gypsum board manufacture
Fundy Gypsum Company	Wentworth and Miller Creek	Open-pit mining of gypsum and anhydrite
Georgia-Pacific Corporation	Sugar Camp	Open-pit mining
Little Narrows Gypsum Company	Little Narrows	Open-pit mining of gypsum and anhydrite
National Gypsum (Canada) Ltd.	Milford	Open-pit mining
NEW BRUNSWICK		
Westroc Inc.	McAdam	Wallboard manufacture
QUEBEC		
CGC Inc.	Montréal	Wallboard manufacture
	Saint-Jérôme	Wallboard plant mothballed
Georgia-Pacific Corporation	Montréal	Distribution terminal only
Westroc Inc.	Montréal	Wallboard manufacture
ONTARIO		
CGC Inc.	Hagersville	Underground mining and wallboard manufacture
Georgia-Pacific Corporation	Caledonia	Underground mining and wallboard manufacture
Westroc Inc.	Clarkson	Wallboard manufacture
MANITOBA		
Westroc Inc.	Amaranth	Open-pit mining
	Winnipeg	Wallboard manufacture
ALBERTA		
Georgia-Pacific Corporation	Edmonton	Wallboard manufacture
Westroc Inc.	Calgary	Wallboard manufacture
BRITISH COLUMBIA		
Georgia-Pacific Corporation	Canal Flats	Open-pit mining
	Vancouver	Gypsum products manufacture
Westroc Inc.	Vancouver	Gypsum products manufacture
	Windermere	Open-pit mining

Source: Natural Resources Canada.

TABLE 3. CANADA, GYPSUM PRODUCTION, TRADE AND USE, 1985-2002

	Production (1)	Imports (2)	Exports	Apparent Use (3)
		(tonnes)		
1985	7 760 783	121 802	5 879 664	2 002 921
1986	8 802 805	221 644	5 921 982	3 102 467
1987	9 093 926	217 625	5 704 853	3 606 698
1988 (a)	8 813 760	274 917	5 651 286	3 437 391
1989	8 179 588	291 373	5 357 055	3 113 906
1990	7 977 685	318 114	5 757 327	2 538 472
1991	6 727 221	259 863	4 940 193	2 046 891
1992	7 294 700	260 505	5 010 649	2 544 556
1993	7 563 369	280 581	5 315 618	2 528 332
1994	8 587 303	292 156	5 942 572	2 936 887
1995	8 054 741	177 327	5 565 427	2 666 641
1996	8 201 774	247 208	5 526 010	2 922 972
1997	8 627 772	220 914	5 981 974	2 866 712
1998	8 306 534	96 593	5 552 146	2 850 981
1999	9 345 342	121 048	6 224 830	3 241 560
2000	8 572 464	154 604	6 318 686	2 408 382
2001	7 821 013	243 160	5 596 557	2 467 616
2002 (p)	8 905 978	332 459	5 245 660	3 992 777

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary.

(a) Beginning in 1988, imports and exports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and exports include H.S. class 2520.10.00 (gypsum, anhydrite).

(1) Producers' shipments of crude gypsum. (2) Includes crude and ground, but not calcined. (3) Production plus imports minus exports.

TABLE 4. CANADA, PRODUCTION AND USE OF COAL COMBUSTION PRODUCTS (CCPs), 2002[1,2]

	Fly Ash	Bottom Ash	FGD Gypsum	Other (3)	Total CCPs
			(000 tonnes)		
PRODUCTION					
Produced	4 744	1 886	354	133	7 116
Disposed/stored	3 851	1 664	–	133	5 648
Removed from disposal	10	3	–	–	13
USE (DOMESTIC)					
Cement	382	161	–	–	543
Concrete/grout	423	–	–	–	423
Mining applications	115	–	–	–	115
Roadbase/subbase	8	23	–	–	31
Wallboard	–	–	504	–	504
Other (4)	90	52	–	–	142
Total use	1 017	236	504	–	1 757
Individual use percentage	21	13	142	–	n.a.
Cumulative use percentage	21	19	25	25	25

Sources: Compiled by Natural Resources Canada in cooperation with the Canadian Electricity Association and the Association of Canadian Industries Recycling Coal Ash (CIRCA).
– Nil; n.a. Not applicable; FGD Flue-gas desulphurization.
(1) Reported production of coal combustion products (CCPs) may include both dry and ponded categories. (2) Use (domestic), as reported, includes amounts imported (assumed H.S. codes 2621.00 relating to fly ash and H.S. 2520.10 relating to gypsum). (3) Cfb (circulating fluidized bed) fly ash and bottom ash. (4) Includes waste stabilization and specialty uses such as mineral filler and flowable fill.

TABLE 5. WORLD PRODUCTION OF GYPSUM, 2001 AND 2002

	2001	2002 (e)
	(000 tonnes)	
Canada	7 821	8 906
Australia	3 800	3 800
China	6 800	6 800
France	4 500	4 500
India	2 250	2 300
Iran	11 000	11 000
Japan	5 900	5 800
Mexico	7 500	6 300
Spain	7 500	7 500
Thailand	5 900	6 100
United Kingdom	1 500	1 500
United States	16 300	16 100
Other countries	22 500	22 700
Total world	103 271	103 306

Sources: Natural Resources Canada; United States Geological Survey, January 2003.
(e) Estimated.

Iron Ore

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SUMMARY

Iron ore is one of Canada's most important mineral products in terms of both tonnage and value. On that basis, Canada is the world's ninth largest iron ore producer and ranks fifth for exports. Canada's iron ore production is concentrated in the Labrador Trough, a major geological belt extending through northern Quebec and Labrador. The production in this area comes from three mining operations owned by Iron Ore Company of Canada, Quebec Cartier Mining Company, and Wabush Mines.

Preliminary data indicate that, in 2002, as a result of the strengthening global economy, Canada's iron ore shipments increased by 14.2% compared to the previous year while its iron ore exports rose by 17.1%.

Following an upsurge in demand from the steel industry, which registered a 5.5% hike in pig iron production, world iron ore production is expected to have increased by 7.6% in 2002. Due to increased demand from the People's Republic of China (China), iron ore exports are estimated to reach 499 Mt in 2002, a hike of about 4.5%.

The consolidation and restructuring of the global iron ore industry witnessed in the past two years should continue during the coming years to enable producers to improve their competitiveness through economies of scale. This will help the iron ore and steel industry preserve its market share as a supplier of low-cost, versatile, high-performance material of choice for use in a variety of applications. Any change in the economic situation in Asia is expected to have a marked impact on steel markets and, consequently, on iron ore use. China, for example, one of the fastest growing economies in the world, is expected to continue to look to foreign suppliers to satisfy a large part of its iron ore requirements. These have been rising at an annual growth rate of more than 18% over the past decade. Producers from Brazil, Australia, India, South Africa and Sweden are gearing up their iron ore production to take advantage of this increase in demand from Asia.

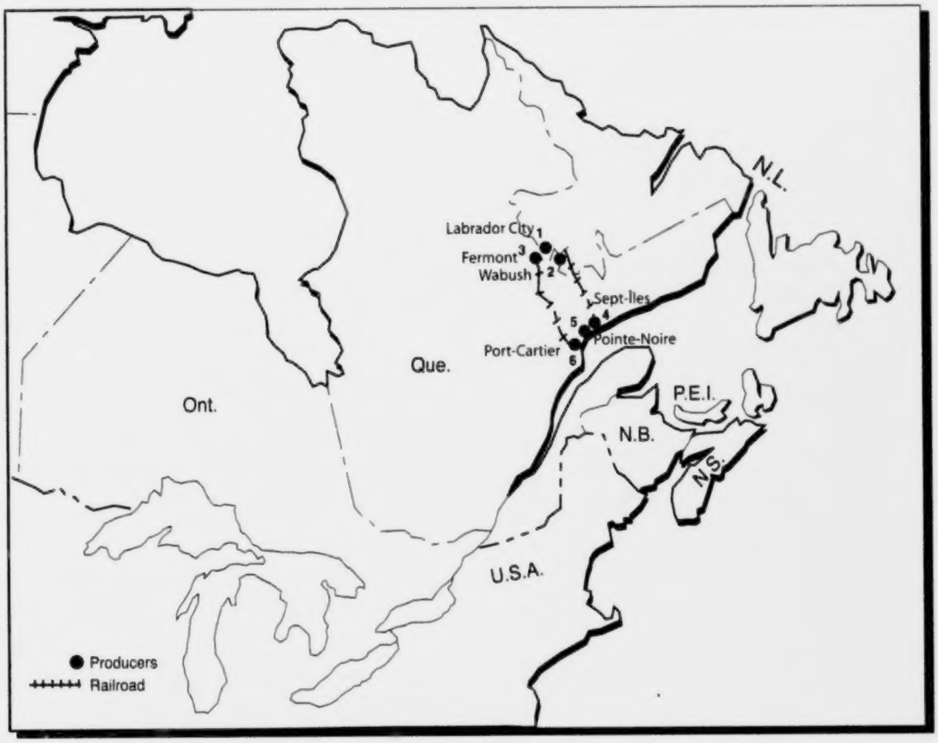
INTRODUCTION

There are two aspects to iron ore demand: quantity and quality. Since the major trade item is in mineral rather than metallic form, there are many chemical and physical variants of iron ore, but they all serve the same purpose – providing the iron component of steel. Steel production in turn is the driving force for almost all iron ore demand. However, technological changes at all stages from iron ore mining to the production of finished steel have been major factors in determining the quantities and the properties of the iron ore demanded. There are two technologies used to produce steel: basic oxygen furnaces, which are charged with molten blast furnace iron and ferrous scrap at the integrated steel mills; and electric arc furnaces, which are charged with scrap and/or direct reduced iron (DRI) at the mini-mill plants. In spite of the introduction of many new materials in this century, worldwide steel industry growth has tended to average about 1% per year over the long term and this trend is expected to continue. However, the growing use of electric arc furnace (EAF) technology may slow the growth in demand for iron ore as 51% of the iron units currently used to make steel in North America come from scrap, an increase of about 6% over six years.

CANADIAN DEVELOPMENTS

Iron ore is one of Canada's single most important mineral products in terms of both tonnage and value. Since the closure in 1998 of the Algoma Iron Ore Division near Wawa, Ontario, nearly all of Canada's iron ore production has been concentrated in the Labrador Trough, a major geological belt extending through northern Quebec and Labrador. Canada's production in this area (Figure 1) comes from three mining operations owned by **Iron Ore Company of Canada** (IOC), **Quebec Cartier Mining Company** (QCM), and **Wabush Mines**. The remaining production comes from the by-product recovery of magnetite from two base-metal smelters in British Columbia.

Figure 1
Iron Ore in Canada, 2002



Numbers refer to locations on map above.

PRODUCERS

1. Iron Ore Company of Canada, Carol Lake Division (mine/concentrator/pellet plant)
2. Wabush Mines (mine/concentrator)
3. Quebec Cartier Mining Company (mine/concentrator)
4. Iron Ore Company of Canada (port)
5. Wabush Mines (pellet plant/port)
6. Quebec Cartier Mining Company (pellet plant/port)

In 2002, as a result of the strengthening global economy, Canada's iron ore shipments reached 30.97 Mt, an increase of 14.2% compared to the previous year. In line with this growth, the value of Canada's production increased by 17.1% to $1.39 billion. Likewise, Canada's iron ore exports registered a 17.1% hike to reach 25.8 Mt, with the pellet market registering an increase of 14.5%, while the concentrate market fared even better, increasing by 24.1%.

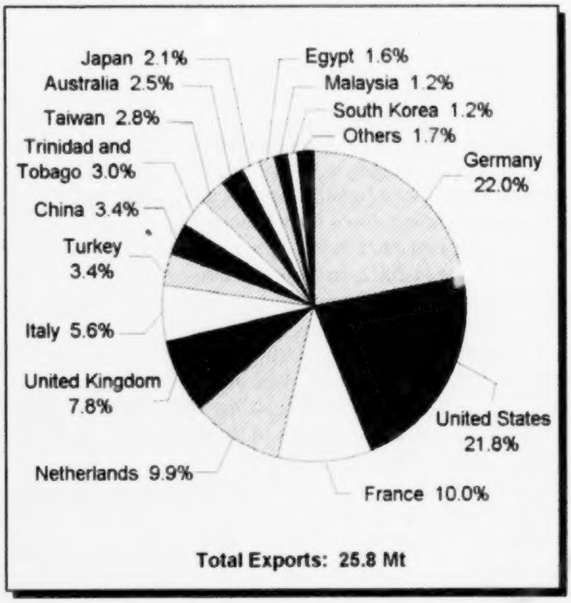
Exports account for more than three quarters of Canada's iron ore shipments with Germany and the United States each accounting for about 22% of Canadian exports while European destinations as a whole account for close to 60% of all shipments of Canadian iron ore. The Canadian industry is, therefore, very sensitive to competition from U.S. mines in the North American market and to competition from countries that ship to the European market. Trade between the United States and Canada is a case in point in 2002 whereby Canada's exports to the United States grew from 4.5 to 5.6 Mt while Canada's imports from the United States also grew from 5.8 to 6.8 Mt, making Canada a net importing country from the United

States. In 2002, the hike in Canadian exports was brought about by increased demand, mostly from European countries, such as France, Germany, the Netherlands and Turkey, and from China, Malaysia and Egypt. On the other hand, Canadian shipments to South Korea, Japan, Italy, Belgium, the United Kingdom (U.K.), and Trinidad and Tobago were adversely affected.

Since acquiring **IOC** in August 2000, Rio Tinto plc (Rio Tinto) has been active in upgrading the Quebec and Labrador installations, as well as its load and haul fleet. In 2002, despite a five-week shut-down, IOC produced 14.7 Mt of ore of which 11.6 Mt were fluxed pellets. The company started the implementation of a major cost reduction program aimed at cutting $120 million by 2005. It also initiated a tailings management program to comply with the new federal Metal Mining Effluent Regulation (MMER). Under this program, IOC will build a dyke to confine its tailings in Wabush Lake and to comply with a suspended solids effluent criterion of 15 mg/L. The first phase of that project is scheduled for completion by 2007.

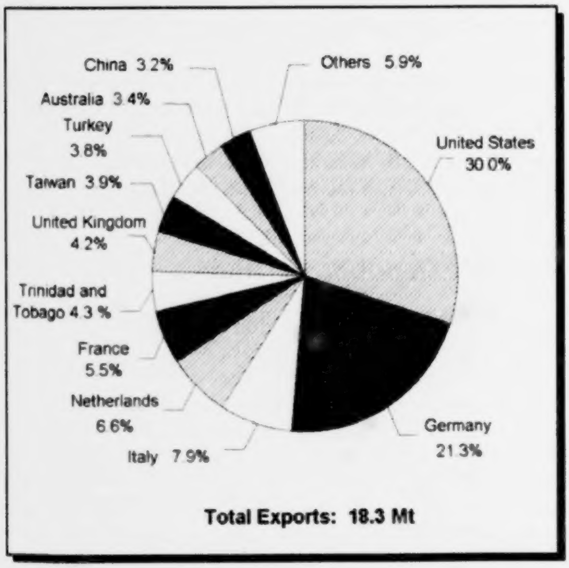
Although details of the agreement were not made public by the end of the year, **QCM** (50:50) co-owners, CAEMI Mineração e Metalurgia S.A. (CAEMI) and Dofasco Inc., announced in December 2002 that they had reached a deal with unnamed investors to sell part of their respective share in the company. The inflow of capital will be used by QCM to finance $350 million of development work

Figure 2
Canadian Iron Ore Exports By Country, 2002



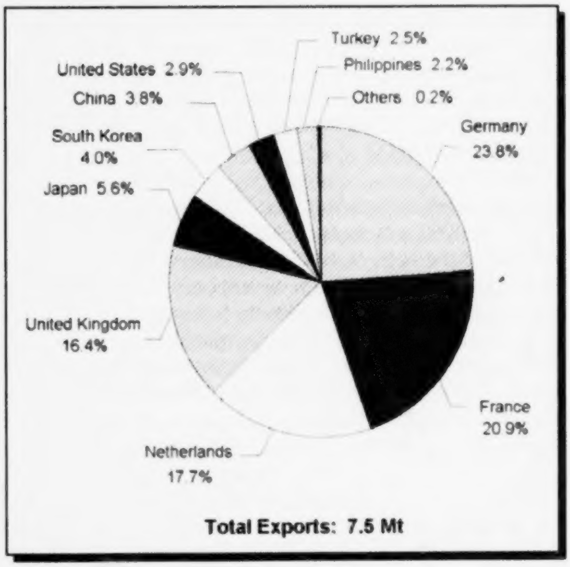
Source: Statistics Canada.

Figure 3
Canadian Iron Ore Pellet Exports By Country, 2002



Source: Statistics Canada.

Figure 4
Canadian Iron Ore Concentrates Exports By Country, 2002



Source: Statistics Canada.

related to stripping heavy rock overburden to get open-pit access to higher-grade ore and to ensure continued operation of the mine at a capacity of 12 Mt for the next 15 years. Dofasco's future cash obligations to finance QCM will not exceed $34.5 million until 2010. Affected by reduced sales, QCM shut down its Mt. Wright operation for six weeks early in the year.

Following up on the strategy it initiated at the end of 2001 in response to changes in the marketplace, **Wabush Mines** operated only two of its three production lines in 2002, effectively scaling down its production level from 6.2 to 4.5 Mt. This resulted in the company producing just under 4.6 Mt of ore in 2002, roughly the same amount as in the previous year. To help improve its competitiveness on a global scale, Wabush Mines underwent a cost reduction and restructuring program during the year. It also proceeded with an important capital investment to address an ongoing operating concern regarding excess water in the pit due to the increasing depth of the operations. The Deep Well dewatering program consists of 11 wells designed to remove some 12 500 gallons per minute from the pit floor. The company estimates that the program will permit dry mining for a period of approximately two years.

INTERNATIONAL DEVELOPMENTS

Preliminary data indicate that, following an upsurge in demand from the steel industry, which registered a 5.5% hike in pig iron production, world iron ore production increased by 7.6% in 2002 to reach 1002.3 Mt,[1] the highest production level ever reached by the industry. Brazil, Australia and China remained the world's largest iron ore producers, accounting for over half of this total. Nonetheless, while all producing countries registered production increases, the highest incremental production increases (of significance) were Brazil (14.7%), Canada (14.2%), the United States (12.4%), India (9.8%), Kazakhstan (9.4%), and Ukraine (7.7%).

Likewise, seaborne trade in iron ore increased 5.5% to 479 Mt in 2002 and was particularly vigorous in the second half of the year. Australia maintained its position as the world's number one iron ore exporting country with exports totalling 185.0 Mt, closely followed, as usual, by Brazil with 169.0 Mt. However, exporting countries that improved their track record the most in 2002 include Brazil and Canada followed by Australia, Chile, Mauritania and Sweden.

WORLD IRON ORE PRODUCTION

	2001	2002
	(000 t)	
Brazil	208 700	239 400
Australia	181 100	187 200
China (1)	102 600	108 800
India	79 200	87 000
Russia	82 500	84 236
Ukraine	54 679	58 897
United States	45 800	51 500
South Africa	34 800	36 500
Canada	27 119	30 968
Venezuela	19 000	20 900
Sweden	19 500	20 300
Kazakhstan	14 100	15 423
Mexico	11 500	12 000
Iran	10 300	11 300
Mauritania	10 300	9 600
Others	30 200	28 300
Total	931 398	1 002 324

Sources: Natural Resources Canada; Macquarie Equities Research; UNCTAD.
(1) A conversion factor was applied to China's production so that its % Fe content is about equal to that, on average, in the rest of the world.

On the demand side, Asia remained the world's most dynamic import market – posting a 6.9% increase over 2001 – where most country economies improved in 2002. Led by Japan, which is the world's largest importer of iron ore (129.1 Mt), the region is nonetheless driven by economies involved in large infrastructure development programs such as in China (111.5 Mt) and South Korea (42.0 Mt). Demand in European Union countries and in Europe in general remained depressed, especially in the U.K., but some improvements were noted in France and Germany. North American overall demand for iron ore pellets remained depressed as both the United States' and Mexico's pig iron production decreased respectively by 4.3% and 8.6% while Canada's increased by 3.4%. Despite this, North American crude steel production increased by 3.4% as more steel was produced using EAF technology.

People's Republic of China

China, the largest producer of iron ore in the world – before the application of a conversion factor to bring its iron content on par with that of other world producers – has tremendous reserves of low-grade iron ore. However, the government's decision to stop subsidizing mines, increasing production costs, and a lack of investment to keep mines operating efficiently resulted in the closure of uneconomic operations and the steady decrease since 1997 of China's domestic iron ore production. On account of this, the country turned to foreign suppliers to satisfy a large part of the iron ore requirements of its steel industry engaged in manufacturing the materials needed to develop the country's infrastructure. China even invested in the development of mines in Australia and Peru in recent years to ensure future supplies. In 2002, China's iron ore supplies were mostly sourced from Australia (38.4%), Brazil (26.7%), India (20.2%) and South Africa (9.2%). However, India and Brazil were successful in gaining market share from Australia in 2002 as a result of the latter's production capacity limits, the European market's lower demand on Brazil's iron ore in recent years, and a reduction in freight rates from Brazil to Asia, which makes the higher-quality Brazilian ore more affordable for consumers who want to blend it with their lower-grade ores.

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[1] A conversion factor was applied to China's production so that its % Fe content is about equal to that, on average, in the rest of the world.

Brazil

Companhia Vale do Rio Doce's (CVRD) acquisitions in recent years of Ferteco Mineração, SA Mineração da Trindade and 50% of CAEMI, giving it direct or indirect control over an estimated 95% of Brazil's iron ore industry, kept the company busy reorganizing in 2002. Still unresolved at the end of the year was the decision to incorporate Ferteco into CAEMI to benefit from the synergies of a joint operation of Ferteco and Minerações Brasileiras Reunidas (MBR), 85% owned by CAEMI. In June 2002, taking advantage of the recovering pellet market, CVRD commissioned a 6.0-Mt-capacity pellet plant in Sao Luis that will bring its total capacity to 46.6 Mt.

To keep pace with a growing market, CVRD intends to invest $6 billion in new projects by 2007 aimed at doubling its exports. Key to this expansion will be CVRD's plan to increase the handling capacity at the company's shipping terminals starting in 2004 with the opening of the No. 3 pier at its Sao Luis, Maranhao terminal, which will boost the terminal's all-cargo shipping capacity from 56 Mt to 70 Mt. In a drive to replace mines near exhaustion, such as the Timbopeba and the Corrego do Meio mines, the company plans to expand iron ore production capacity at its Carajas operation in the Amazon from 55 Mt to 70 Mt for 2005, and by 3 Mt at its Gonco Soco mine in the Minas Gerais area for 2004. These expansions will be complemented by two greenfield mine developments in Minas Gerais: the Fabrica Nova mine in 2005 and the Brucutu mine in 2006 with a capacity of 13 Mt and 12 Mt, respectively. Ferteco, on the other hand, is setting up a new $150 million, 4-to-5-Mt/y pellet plant at its Fabrica mine, which will boost its capacity to 30 Mt. Finally, work on a $38 million project to upgrade by 10% to 13.8 Mt the pellet capacity of the Samarco Mineracão SA plant, a 50:50 CVRD-BHP Billiton joint venture, should be finalized by April 2003. Samarco's pellet production reached 12.3 Mt in 2002, of which 37% was shipped to China. CVRD expects to increase its 2003 output by 4-5%.

MBR, Brazil's second largest iron ore producer, is about two thirds through a long-term development plan to replace mines and expand its production from 29 Mt in 2002 to 37 Mt in 2007. Other than production from MBR's flagship operation, the Pico Complex, which produced 11.6 Mt of mostly hematite ore in 2002, the company is counting on production from Vargem Grande and Capitao do Mato, as well as on new production from the Tamandua Complex (2002) and the Capao Xavier mine (2003), to replace depleted reserves at the Mutuca mine (2001) and the Aguas Claras mine (October 2002).

Australia

Australia, the world's largest iron ore exporter, produced 187.2 Mt of ore in 2002, a 3.4% increase over 2001. This production is essentially controlled by Rio Tinto (47.3%), BHP Billiton Plc (40.0%), Mitsui & Co., Ltd. (6.0%), and Portman Ltd. (2.3%). Rio Tinto's share of Australia's iron ore production comes from its wholly owned Hamersley Iron Pty., Ltd. operations and its 53% share in Robe River Mining Co. Pty Ltd. In 2002, despite strong demand from China, and from Japan and South Korea for Yandi fines, Hamersley's output decreased by 2.5%. However, drawing from stockpiles at its operations, which include the Mt. Tom Price, Paraburdoo, Marandoo, Brockman No. 2, and Yandicodgina mines, and its 60% share of the Channar mine, the company increased its sales by about 4.8% to 68.5 Mt.

Building on the start-up in June 2002 of the West Angelas deposit, Robe River increased its production by 16.8% to 35.9 Mt and its shipments by 13.8% to 35.4 Mt. Developed at a cost of about $700 million, the West Angelas mine started producing at a 7-Mt capacity and is expected to reach its designed capacity of 20 Mt by 2007. Project costs included the expansion of rail links and of the Cape Lambert port facilities to increase its handling and shipping capacity from 32 to 50 Mt.

BHP Billiton's iron ore production in Australia increased by 3.9% to 63.1 Mt in 2002, with ore coming from its 85% ownership of the Mt. Newman (21.8 Mt), Goldsworthy (6.8 Mt), and Yandi (29.3 Mt) mines and from its wholly owned Jimblebar project (5.3 Mt). In order to deal with additional ore production capacity at the Yandi mine, where a 4-Mt capacity for lump product was introduced in 2002, the company realized efficiency improvements by increasing its ship-loading capacity at the company's port facilities at Nelson Point and by increasing its rail capacity by optimizing the tonnage in rail cars through a new loading system. BHP Billiton also pursued its larger $540 million PACE project to enable it to increase its export capacity by 10 Mt and to handle additional ore production from its $328 million, Area C, 15-Mt/y Marra Mamba ore project, scheduled for commissioning in October 2003. The first stage of the PACE project is set to increase BHP

Billiton's capacity to 81 Mt by mid-2004 while further stages could push capacity to more than 90 Mt.

Other projects under development in Australia include the Hope Downs project owned (50:50) by South Africa's Kumba Resources limited and Australia's Hancock Resources Limited. Slated to begin production in 2006 at an initial output of 5 Mt, this operation will have a 25-Mt capacity and will produce Marra Mamba ore with a 38:62 lump-to-fines ratio. However, the project faced a setback in 2002 with the ruling by the Supreme Court of Western Australia denying access to BHP Billiton's Mt. Newman rail line, which would have saved the project about $250 million in infrastructure costs.

India

Directly competing for market share with Australia – as shown by its 33% increase in exports to China in 2002 over the previous year – India's iron ore industry has been steadily expanding over the past decade. This tendency may even accelerate in coming years with the gradual liberalization of exports from India as shown by the respective hikes in exports of 13.3% and 12.6% in 2001 and 2002. About 52% of India's iron ore production is currently controlled by public sector units such as the National Mineral Development Corp., Kudremukh Iron Ore Co. Ltd. (KIOCL), the Steel Authority of India Ltd. (SAIL), and Orissa Mining Corp., while Minerals & Metals Trading Corp. (MMTC), India's state trader, canalizes 64%+ Fe iron ore exports. However, the expected privatization of MMTC and the depletion of reserves at KIOCL's operation near Mangalore by the end of 2005 will reduce the state's hold on the industry. In light of the country's excellent high-grade ore reserves and liberalizing trade rules, prospects for further exports look bright. However, improvements to port and rail facilities, as well as the development of new mines, will be required.

Russia

Pursuing the revival of its industry initiated by the devaluation of the rouble in 1998, which gave it a competitive cost advantage, Russian production of iron ore increased by 1.4% to 84.2 Mt in 2002 and included 29.8 Mt of pellets. Russia's iron ore comes from a few large producers such as Lebedensky GOK (18.4 Mt), Mikhailovsky GOK (15.1 Mt), Stoilensky GOK (12.6 Mt), and Kachkanarsky GOK (7.8 Mt), and from numerous mines with a capacity of less than 2 Mt each. Roughly 70% of this production is used domestically while the rest is exported to supply Ukraine's growing steel industry and Eastern European countries. Russia also exports significant amounts to Germany, Turkey, Finland and Norway.

Ukraine

Responding to growing internal demand, iron ore production in Ukraine – the former Soviet Union's second largest iron ore producer – reached 58.9 Mt in 2002, an increase of 7.7% compared to 2001. Ukraine's iron ore industry comprises a dozen producers of which the largest are: Inguletsky GOK (12.4 Mt), Yuzhny GOK (7.6 Mt), Severny GOK (7.1 Mt), Novokrivorozhsky GOK (6.7 Mt), and Poltavsky GOK (6.7 Mt). In the case of Poltavsky and Severny, which are currently being privatized, their output is mostly in the form of pellets. As for Kazakhstan's production, which is essentially controlled by the Sokolov-Sarbai Mining Production Association, it increased by 8.1% in 2002 to reach 15.4 Mt, including 7.3 Mt of pellets.

United States

The U.S. iron ore industry was also busy reorganizing as Cleveland-Cliffs Inc. acquired Algoma Steel's 45% interest in the Tilden mine, increasing its ownership in the latter to 85%. During the year, Cliffs also increased its ownership in the Hibbing mine to 23% and in the Empire mine to 79% by acquiring LTV Steel Mining Company's and Ispat Inland Inc.'s respective 25% and 19% interest in the latter mine. These transactions may lead to a combination of the operations of the Tilden and Empire mines before the end of 2003 and result in a more efficient and cost-competitive mining operation. Cliffs' share of iron ore pellet production in 2002 from the mines it manages (Empire, Tilden, Hibbing, Northshore and Wabush) was 13.3 Mt despite the extended shut-down of the Empire mine that began early in the year. Cliffs is projecting that total mine production will increase by close to 17% in 2003 to 29.6 Mt. Meanwhile, the Minntac iron ore mine, the United States' largest producer with a 16-Mt pellet capacity, completed a six-year $75 million upgrade of its concentrator facility in May 2002 to improve its cost-effectiveness.

Republic of South Africa

Consolidation may also start to occur in the South African iron ore industry following the Anglo American plc (Anglo) acquisition in March 2002 of a 20.1% stake in Kumba Resources Limited (Kumba) and a 34.9% stake in Anglovaal Mining Limited (Avmin). With these purchases, Anglo enters the iron ore business with Kumba's ownership of the Sishen and Tabazimbi mines (25-Mt capacity) and Avmin's 53% ownership of Assmang Limited, which operates the Beeoshoek mines (6-Mt capacity). South Africa's production in 2002 reached 36.5 Mt, of which about 21 Mt was exported to China (49%) and Japan (22.5%) while the rest went to Europe.

Sweden

Luossavaara Kiirunavaara AB (LKAB), the world's fifth largest iron ore exporter, produced 20.3 Mt of ore in 2002 – including 14.0 Mt of pellets – an increase of 4.1% over the previous year. Capitalizing on the strong Chinese market, the company increased its exports by 4.4% to 14.2 Mt, of which 0.3 Mt went to China. LKAB is planning to increase its sales to China to the 1-Mt level in 2003 and in the mid term to a 1.0- to 1.5-Mt level. The company reports having completed a major investment program to increase its pellet capacity to 16.3 Mt and to extend the life of its two underground mines, including the development of a new main level at the Malmberget mine and the development of the Kiruna orebody under Lake Luossajavari.

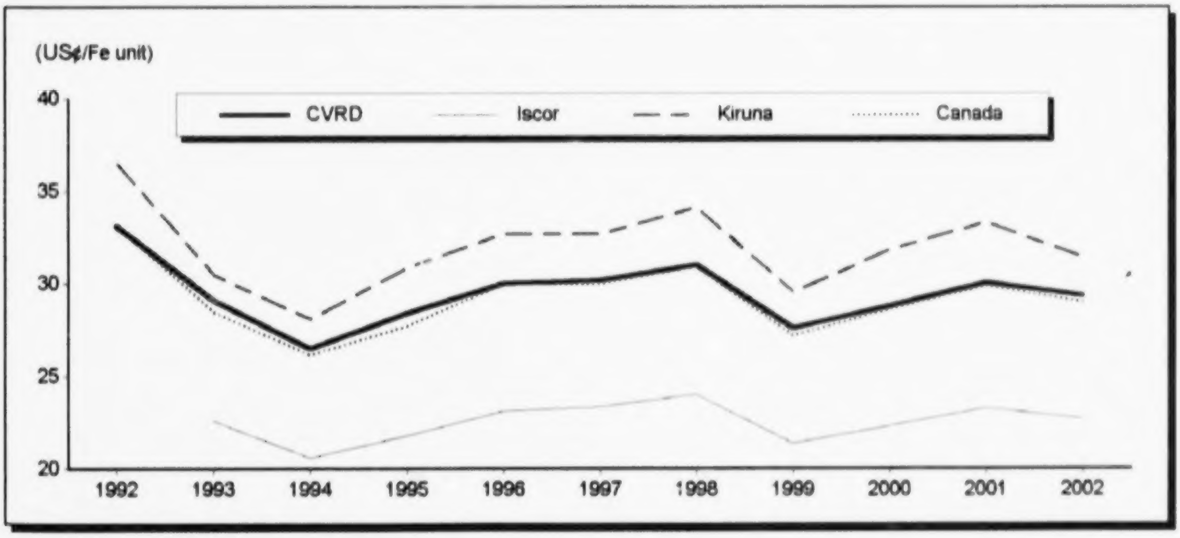
PRICES

Agreements on iron ore prices were finally settled on the European and Japanese markets at the end of May 2002, the latest the industry has ever experienced. Despite indications that demand for iron ore was recovering globally and that strong demand from Asia, particularly China, would exert some pressure on the availability of supplies, iron ore producers agreed on a price reduction for 2002.

This year's iron ore price negotiations were first settled between Brazil's CVRD and European steelmakers, followed by Australian suppliers and Japanese mills who settled on a similar accord. For concentrate bound for Europe and Japan, the price decrease was set at around 2.4% for most grades, although Canadian and Swedish concentrate was reduced by 3.01% and 5.62%, respectively. Similarly, the price of pellets bound for Europe and Japan decreased in the range of 5.47-7.64% while the price of lumps fell by 5.00%.

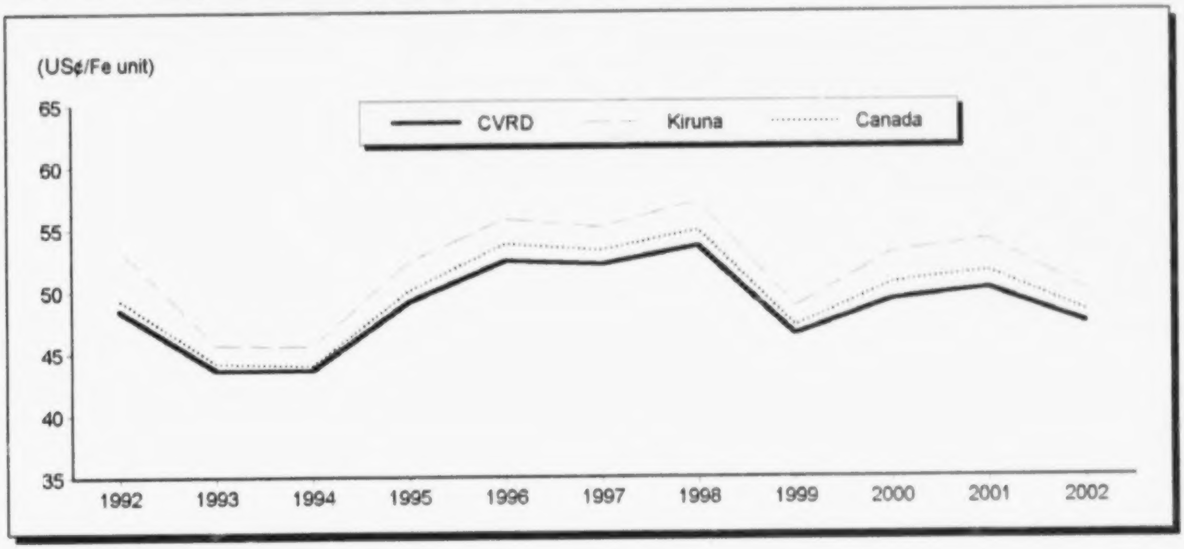
Negotiations for 2003 iron ore deliveries got under way in mid-December 2002 and appear set to result in a price hike in the 5-7% range. Aspects favouring this outcome include the steel price increases witnessed in 2002 and China's increasing iron ore demand, which may result in a scarcity of supplies on the markets. However, uncertainties related to the vigour of the economic recovery in Europe and in North America, and the impact of a potential military intervention in the Middle East, may limit upward pressure on prices. In any case, as outlined in Figure 7, any price increase agreed upon, minimized by the application of the inflation rate, will require iron ore producers to pursue their cost-cutting measures to remain competitive.

Figure 5
Iron Ore Price, Fines Bound for Europe, 1992-2002



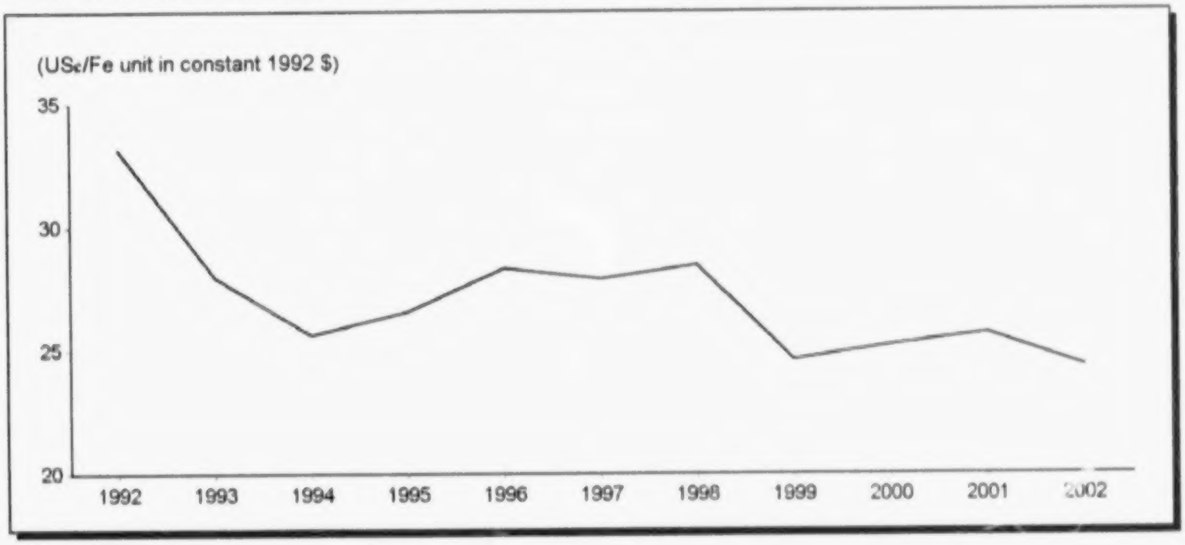
Sources: *The Tex Report*; UNCTAD.

Figure 6
Iron Ore Price, Pellets Bound for Europe, 1992-2002



Sources: *The Tex Report*; UNCTAD.

Figure 7
Iron Ore Price Variations, Canadian Concentrate Bound for Europe, 1992-2002



Sources: Natural Resources Canada; *The Tex Report*; UNCTAD.

OUTLOOK

The consolidation and restructuring of the global iron ore industry witnessed in the past two years should continue during the coming years, enabling producers to improve their competitiveness through economies of scale. This will help the iron ore and steel industry preserve its market share as a supplier of low-cost, versatile, high-performance material of choice for use in a variety of applications.

Any change in the economic situation in Asia is expected to have a marked impact on steel markets and, consequently, on iron ore use. China, one of the fastest-growing economies in the world, is expected to continue to look to foreign suppliers to satisfy a large part of its iron ore requirements. Chinese imports of iron ore rose from 14.3 Mt in 1990 to over 111.5 Mt in 2002, representing an annual growth rate of over 18%. The development of a more modern market economy in China and the demand for higher-quality products are expected to lead that country to maintain or increase its present level of imports. Based on this situation and on increased demand from North American steel producers, world iron ore production is forecast to reach 1013 Mt in 2003, an increase of about 1%, while seaborne trade is forecast at 514 Mt.

Despite the recent appreciation of the Canadian dollar versus the U.S. dollar, which will reduce their competitiveness on international markets, Canadian producers should be able to take advantage of this increased trade. Canadian shipments of iron ore are therefore forecast to reach a level of around 32 Mt in 2003 with Wabush Mines producing in the range of 4.8 Mt in 2003, QCM in the order of 12 Mt, and IOC a level of 15.8 Mt.

In the short term, the reduced price spread between fines and pellets and the forecast tight supply of low residual scrap, which should encourage the production of DRI and iron carbide, will boost demand for pellets, especially DRI-grade pellets. This situation and the long-term trend for increased pellet use to supply the growing use of EAF in steelmaking may cause Canadian producers to re-evaluate their investment decisions and reactivate pellet capacity, such as IOC's Sept-Îles plant. Nonetheless, the Canadian industry will continue to face challenges to remain competitive because of the lower grade of Canadian ore relative to several competitors on the international market. So far, however, as indicated in Figure 8, the companies have been able to meet the challenge and keep a fairly even production level throughout the past decades through quality programs and restructuring.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of January 1, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

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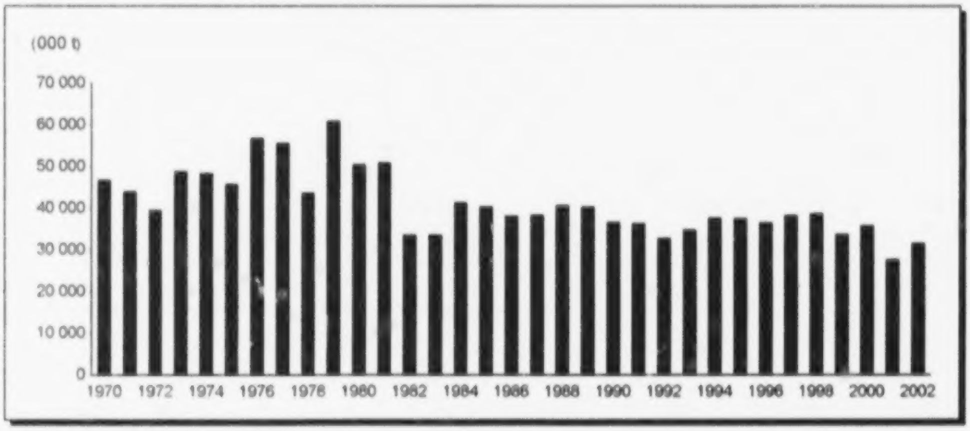
Figure 8
Canadian Iron Ore Production, 1970-2002



Source: Natural Resources Canada.

TABLE 1. CANADA, IRON ORE PRODUCTION AND TRADE, 2001 AND 2002

Item No.		2001		2002 (p)	
		(tonnes) (1)	($000)	(tonnes) (1)	($000)
PRODUCTION (mine shipments)					
	By province				
	Newfoundland and Labrador	17 486 322	798 238	19 376 953	895 477
	Quebec	9 560 479	x	11 500 000	x
	British Columbia	72 480	x	92 314	x
	Total (2)	27 119 281	1 188 928	30 969 267	1 391 692
IMPORTS					
2601.11	Iron ore concentrates, non-agglomerated				
	United States	91 194	2 196	24 535	661
	Peru	3	...	26 190	557
	Spain	–	–	164	6
	France	35	1	112	5
	Germany	29	1	111	2
	Other countries	334	12	35	...
	Total	91 595	2 210	51 147	1 231
2601.12	Iron ore, agglomerated				
	United States	5 814 337	332 368	6 793 385	375 266
	Other countries	2	...	151	7
	Total	5 814 339	332 368	6 793 536	375 273
EXPORTS					
2601.11	Iron ore concentrates, non-agglomerated				
	Germany	1 697 483	47 215	1 794 390	54 560
	Netherlands	830 757	24 200	1 332 628	37 544
	France	535 186	11 387	1 576 558	36 118
	United Kingdom	1 124 106	29 838	1 231 630	31 906
	Japan	822 119	21 802	420 040	11 240
	Turkey	–	–	186 491	9 550
	China	164 980	4 666	288 218	8 235
	Philippines	57 979	986	168 685	7 621
	South Korea	482 153	13 807	298 379	7 600
	United States	339 143	10 602	220 230	5 703
	Australia	15 703	443	14 998	418
	Total	6 069 609	164 946	7 532 247	210 495
2601.12	Iron ore, agglomerated				
	United States	4 187 959	195 991	5 374 954	242 367
	Germany	3 245 483	157 796	4 061 355	197 870
	Italy	1 691 891	83 015	1 432 491	71 192
	Netherlands	955 690	48 791	1 199 889	59 904
	France	251 732	12 625	999 320	50 207
	Trinidad and Tobago	1 253 566	73 983	777 590	44 074
	United Kingdom	1 213 452	57 934	764 134	36 118
	Turkey	292 342	14 433	682 046	34 045
	Taiwan	659 138	31 411	713 034	33 670
	Australia	952 449	44 553	618 303	30 946
	China	427 394	21 453	586 988	29 328
	Egypt	136 055	6 495	415 369	18 290
	Malaysia	148 571	7 912	306 354	15 149
	Switzerland	59 801	2 855	139 005	6 635
	Japan	80 871	3 988	131 050	6 582
	Hungary	–	–	42 099	1 999
	Qatar	–	–	35 533	1 798
	Saudi Arabia	–	–	35 389	1 791
	Belgium	308 148	14 709	–	–
	South Korea	45 897	2 289	–	–
	Philippines	85 145	2 725	–	–
	Portugal	–	–	–	–
	Total	15 995 584	782 958	18 314 903	881 965

TABLE 1 (cont'd)

Item No.	2001		2002 (p)	
	(tonnes) (1)	($000)	(tonnes) (1)	($000)
EXPORTS (cont'd)				
Total exports, all classes				
Germany	4 942 966	205 011	5 855 745	252 430
United States	4 527 102	206 593	5 595 184	248 070
Netherlands	1 786 447	72 991	2 532 517	97 448
France	786 918	24 012	2 575 878	86 325
Italy	1 691 891	83 015	1 432 491	71 192
United Kingdom	2 337 558	87 772	1 995 764	68 024
Trinidad and Tobago	1 253 566	73 983	777 590	44 074
Turkey	292 342	14 433	868 537	43 595
China	592 374	26 119	875 206	37 563
Taiwan	659 138	31 411	713 034	33 670
Australia	968 152	44 996	633 301	31 364
Egypt	136 055	6 495	415 369	18 290
Japan	902 990	25 790	551 090	17 822
Malaysia	148 571	7 912	306 354	15 149
Philippines	143 124	3 711	168 685	7 621
South Korea	528 050	16 096	298 379	7 600
Switzerland	59 801	2 855	139 005	6 635
Hungary	–	–	42 099	1 999
Qatar	–	–	35 533	1 798
Saudi Arabia	–	–	35 389	1 791
Belgium	308 148	14 709	–	–
Portugal	–	–	–	–
Total	22 065 193	947 904	25 847 150	1 092 460

Sources: Natural Resources Canada; Statistics Canada; American Iron Ore Institute.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.
(1) Dry tonnes for production (shipments) by province or territory; natural weight for imports and exports. (2) Total iron ore shipments include shipments of by-product iron ore.

TABLE 2. CANADA, IRON ORE SHIPMENTS, 1997-2002

Company and Location	Ore Mined	Product Shipped	1997	1998	1999	2000	2001	2002 (p)
					(natural (wet))			
Algoma Ore Division Algoma Steel Inc. Wawa, Ontario	Siderite	Sinter (1)	795	651	–	–	–	–
Iron Ore Company of Canada Schefferville, Quebec	Hematite, goethite and limonite	Direct shipping	–	–	–	–	–	–
Carol Lake, Newfoundland and Labrador	Specular hematite and magnetite	Concentrate	4 678	5 172	3 983	3 955	3 415	3 151
		Acid pellets	. .	. .	2 408	. .	. .	. .
		Fluxed pellets	11 372	12 248	3 190	11 466	9 908	11 566
		Limestone pellets	. .	. .	3 870	. .	. .	. .
		Direct reduced pellets	. .	. .	211	. .	. .	. .
		Chips	. .	. .	. .	. .	. .	. .
Loadstone Limited Newfoundland and Labrador	Magnetite	Concentrate	100	–	–	–	–	
Quebec Cartier Mining Company Mt. Wright, Quebec	Specular hematite	Concentrate	7 159	6 757	6 304	6 163	(r) 3 465	4 020
		Acid pellets	3 795	3 577	2 820	. .	(r) 2 155	1 600
		Self-fluxed pellets	4 324	2 824	3 036	8 234	(r) 2 023	2 586
		Low-Si pellets	225	1 638	1 591	. .	(r) 1 085	3 045
		Low-Si self-fluxed pellets	–	103	1 045	. .	(r) 1 051	965
Wabush Mines Wabush, Labrador and Pointe-Noire, Quebec	Specular hematite and magnetite	Acid pellets	3 440	3 127	3 223	5 983	2 945	3 455
		Fluxed pellets	2 257	2 518	2 009	. .	1 499	1 024
		Concentrate	. .	. .	35	. .	. .	. .
		Chips	. .	. .	. .	. .	110	81
British Columbia producers	Magnetite	Concentrate	100	102	92	102	(r) 72	92
Total			38 245	38 717	33 790	35 903	(r) 27 728	31 585

Source: Natural Resources Canada.
– Nil; . . Not available; (p) Preliminary; (r) Revised.
(1) Includes about 400 000 t of iron-bearing material not from the mine.

TABLE 3. RECEIPTS, USE AND INVENTORIES OF IRON ORE AT CANADIAN IRON AND STEEL PLANTS, 2001 AND 2002

	2001	2002
	(000 tonnes)	
Receipts imported	5 974	6 924
Receipts from domestic sources	6 444	6 252
Total receipts at iron and steel plants	12 418	13 176
Use of iron ore	12 381	13 057
Inventory at docks, plants, mines and furnace yards, December 31	10 420	7 625
Inventory change	1 602	-2 795

Source: American Iron Ore Association.

TABLE 4. SELECTED PRICES OF IRON ORE BOUND FOR JAPAN AND EUROPE, 1988-2002

Ore	Market	Source	1988	1990	1992	1994	1996	1998	2000	2001	2002
					(US¢/Fe Unit Dmt, f.o.b.)						
Fines (including concentrate)	Europe	CVRD	23.50	30.80	33.10	26.47	30.00	31.00	28.79	30.03	29.31
		Iscor	20.55	24.75	–	20.60	23:10	24.01	22.30	23.26	22.70
		Kiruna	26.00	35.70	36.50	28.10	32.70	34.10	31.83	33.30	31.43
		Carol Lake	23.69	31.78	33.15	26.15	30.00	30.90	28.60	29.90	29.00
		Mt. Wright	23.69	31.78	33.15	26.15	30.00	30.90	28.60	29.90	29.00
	Japan	CVRD	20.90	27.38	28.11	22.65	25.89	26.89	25.01	26.06	25.45
		Iscor	17.75	23.62	24.24	19.21	21.55	20.65	20.80	21.69	21.17
		Hamersley (2)	23.31	30.54	31.35	25.26	28.33	29.45	27.35	28.52	27.83
		Carol Lake	19.93	26.11	27.26	21.96	24.63	25.60	23.78	24.80	24.21
Lump	Europe	Iscor	23.50	33.00	32.29	28.00	32.13	(r) 33.07	31.41	32.42	30.80
		Hamersley (1)	33.15	49.97	48.28	40.28	46.82	47.94	45.56	47.21	42.73
	Japan	CVRD	21.89	29.22	29.00	24.38	27.63	28.44	27.02	27.89	26.50
		Iscor	21.99	30.21	30.27	26.15	30.50	31.40	29.36	30.31	28.79
		Hamersley (2)	28.33	38.53	38.23	32.74	37.09	38.18	36.26	37.43	35.56
Pellets	Europe	CVRD	36.70	51.60	48.47	43.64	52.40	53.56	49.24	50.10	47.36
		Kiruna	41.15	59.00	53.48	45.60	55.80	57.20	53.00	54.08	49.95
		Carol Lake	37.15	52.58	49.35	44.00	53.80	54.88	50.60	51.53	48.30
		Mt. Wright	37.15	52.58	49.35	44.00	53.80	54.88	50.60	51.53	48.30
	Japan	CVRD (Nibrasco)	35.04	46.50	45.57	41.03	49.26	50.34	46.29	47.10	44.52
		Savage River	34.17	45.90	43.12	38.83	46.62	47.65	43.80	44.57	-

Sources: *The Tex Report; Skillings Mining Review*; UNCTAD.

– Nil; Dmt Dry metric tonne; f.o.b. Free on board; (r) Revised.

(1) c.i.f. Rotterdam. (2) f.o.b. Dampier.

Note: Price is reported in cents, U.S. currency, for each percentage point of iron in a tonne of ore, e.g., at 30¢/Fe unit, ore grading 65% iron would bear a price of 65 x 30¢ = US$19.50/t.

Lead

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Canada is an important world producer and supplier of refined lead, ranking seventh in mine production in 2002 after the United States, China, Germany, the United Kingdom, Australia and Japan. In Canada, primary lead is produced mainly as a co-product of zinc. Recycling of lead, mainly from scrapped car batteries, is an important source of refined lead in Canada, representing nearly 50% of the total refined production.

HISTORY OF LEAD

Lead has been known since ancient times and is one of several metals that were discovered during the early periods of human history. Some experts believe that lead was used as early as 5000 B.C. The oldest archaeological evidence of lead use by humans is a figurine found in the Dardanelles area of Asia Minor dating from 3800 B.C.

Lead was used in coinage in China about 2000 B.C. and was mined by the Greeks from about 1200 B.C. to make coins, ornaments, weights and many other articles. One of lead's most enduring uses has been as pipe for the transportation of water. Romans manufactured lead pipes in one standard length and in several diameters, and used it extensively in municipal water systems. The Roman word for lead is "plumbum," which led to the modern English words "plumber" and "plumbing." The chemical symbol for lead, Pb, was also derived from the Latin word.

LEAD IN CANADA

An outcrop of lead-zinc ore was discovered in the Kootenay region of British Columbia in the 1820s. Active prospecting in the area dates from 1865 and mining commenced shortly thereafter. In the early years, the ores from British Columbia were sent to the United States for smelting and refining.

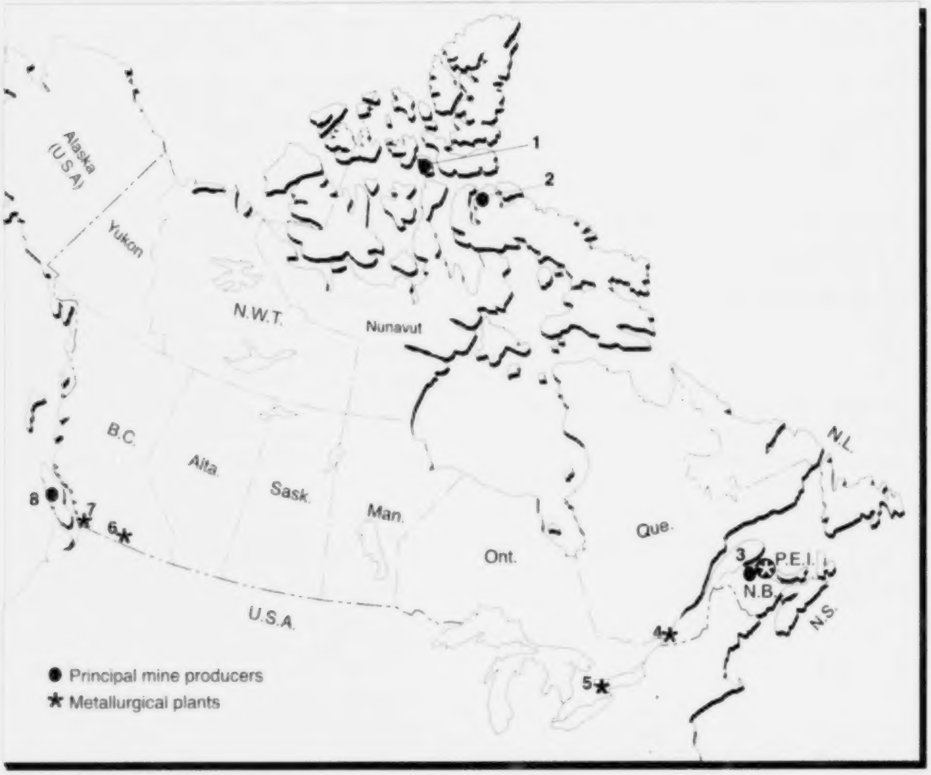
The now-famous Sullivan mine started operation near Kimberley, British Columbia, in the early 1900s and continued to produce lead until its closure in December 2001. By 1914, the Sullivan mine was the largest lead producer in Canada, a position it held for 50 years until the Pine Point mine in the Northwest Territories completed its first year of operation in 1966. Pine Point closed in 1988. The Kingdon mine at Galetta, on the Ottawa River near Arnprior, Ontario, was discovered in 1884, operated briefly in the 1880s, and was reactivated in 1914, producing lead and zinc ore until the early 1930s. The discovery of lead and zinc ores by the Geological Survey of Canada on Baffin Island in the mid-1950s led to the development of the Nanisivik mine in the mid-1970s. The mine closed in September 2002. The discovery of lead-zinc on Little Cornwallis Island in 1971 led to the development of the Polaris mine. Operated by Teck Cominco, the mine had the distinction of being the most northerly base-metal mine until its closure at the end of August 2002 after 20 years of operation.

Today Noranda's operation at the Brunswick mine near Bathurst, New Brunswick, is the largest producer of lead. Lead has been mined in every province and territory with the exception of Alberta, Saskatchewan and Prince Edward Island. Operations in 2002 are listed in Figure 1.

USES

The largest single use of lead today is in the manufacture of the lead-acid storage battery, a vital part of every automobile. The average car battery contains about 10 kg of lead. Lead-acid batteries for automotive, industrial and consumer purposes account for about 75% of the world's demand for lead. In the communications industry, lead is still used extensively as protective sheathing for underground and underwater cables, including transoceanic cable systems. Certain lead compounds are used as paint pigments. Red lead (lead oxide) is the basic paint primer for iron and steel. Lead's corrosion-resistant nature also makes it suitable for applications in sheeting for roofing purposes, while its radiation attenuation properties prevent the emission of harmful radiation from television, video and computer screens.

Figure 1
Lead Producers in Canada, 2002

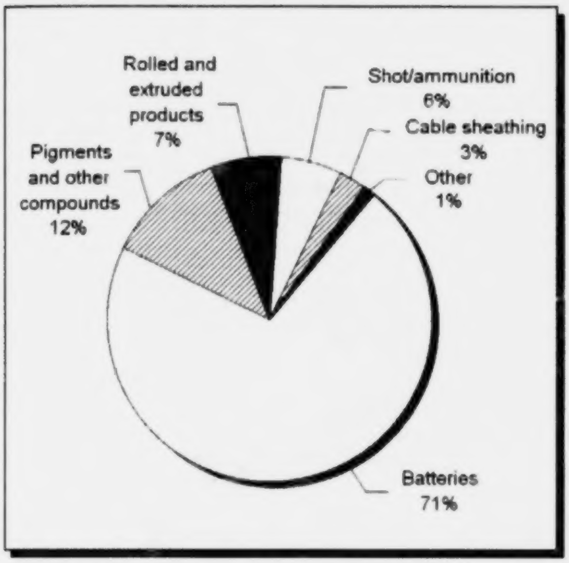

Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
N.L.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
4
5
6
7
8
● Principal mine producers
★ Metallurgical plants

Numbers refer to locations on map above.

LEAD-PRODUCING MINES	WEB SITE
1. Polaris, Teck Cominco Limited (closed September 2002)	www.teckcominco.com
2. Nanisivik, Breakwater Resources Ltd. (closed September 2002)	www.breakwater.ca
3. Brunswick, Noranda Inc.	www.noranda.com
8. Myra Falls, Boliden Limited	www.boliden.ca

LEAD METALLURGICAL PLANTS	
3. Belledune, Noranda Inc.	www.noranda.com
4. Nova Pb Inc. General Smelting Company of Canada	www.novapb.com
5. Tonolli, Tonolli Canada Ltd. and Canada Metal Company	
6. Trail, Teck Cominco Limited	www.teckcominco.com
7. Metalex Products Ltd.	

Figure 2
Western World Lead Markets, 2001



Source: International Lead and Zinc Study Group.

NATURAL OCCURRENCE

Almost all lead is obtained from sulphide ores in which the most common lead mineral is galena (PbS). It is usually found in combination with other sulphide ores, most frequently those of zinc, and also those of copper. Other lead-containing minerals include cerrusite ($PbCO_3$) and anglesite ($PbSO_4$).

PRICE OUTLOOK

Cash London Metal Exchange (LME) settlement prices for lead traded between US\$450 and \$500/t over the year. Prices peaked at US\$538/t in early January and then fell to reach a minimum for the year of US\$402.50/t in October. Prices rallied somewhat to trade in the \$450-\$470/t range at the end of November, falling back to end the year at \$421/t. Overall, lead prices averaged US\$452.52/t for the year. LME stocks followed a steady rise from a minimum of 97 000 t at the start of January and rose to a peak of 197 400 t in early August. They then continued a slow downward decline to reach 183 900 t by the end of December, but were still almost double the amount at the start of the year.

Lead concentrate markets have been particularly tight as older mines close and few new projects with significant amounts of lead come on stream. The tight market is already being reflected by lower treatment charges and cutbacks at some smelters. Overall, taking into consideration the information provided by the member countries of the International Lead and Zinc Study Group (ILZSG), it is expected that there will be a modest deficit of just under 50 000 t in the Western World market for refined lead metal in 2003. This should translate into higher prices over the coming months with lead prices expected to average between US\$500 and \$550/t to the year 2005.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 30, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

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TARIFFS

		Canada			United States	EU	Japan
Item No.	Description	MFN	GPT	USA	Canada (1)	MFN	WTO (1)
2607.00	Lead ores and concentrates	Free	Free	Free	Free	Free	Free
78.01	Unwrought lead						
7801.10	Refined lead						
7801.10.10	Pig and block	Free	Free	Free	Free	2.5%	Free-2.70 yen/kg
7801.10.90	Other	2.5%	Free	Free	Free	2.5%	Free-2.70 yen/kg
7801.91	Other: Containing by weight antimony as the principal other element	Free	Free	Free	Free	2.5%	Free to 2.8% or 3.10 yen/kg
7801.99.10	Lead bullion	2.5%	Free	Free	Free	Free	3% or 4.50 yen/kg
7801.99.20	Lead alloys	2.5%	Free	Free	Free	2.5%	Free to 2.8%
7801.99.90	Unwrought, other	2.5%	Free	Free	Free	2.5%	Free-2.70 yen/kg
7802.00	Lead waste and scrap	Free	Free	Free	Free	Free	2.1%
7803.00	Lead bars, rods, profiles and wire						
7803.00.10	Bars and rods, not alloyed	2.5%	Free	Free	Free	5%	3%
7803.00.90	Bars and rods of lead-antimony-tin alloys	3%	Free	Free	Free	5%	3%
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) not exceeding 0.2 mm						
7804.11.10	Of lead-tin alloys, whether or not containing antimony	Free	Free	Free	Free	5%	3%
7804.11.90	Other	3%	Free	Free	Free	5%	3%
7804.19	Lead plates, sheet, strip and foil, n.e.s.						
7804.19.10	Not alloyed, of a thickness exceeding 0.2 mm but not exceeding 5 mm, and a width exceeding 600 mm	2.5%	Free	Free	Free	5%	3%
7804.19.20	Of lead-antimony-tin alloys	2.5%	Free	Free	Free	5%	3%
7804.19.90	Other	2.5%	Free	Free	Free	5%	3%
7804.20	Powders and flakes						
7804.20.10	Powders, not alloyed	2.5%	Free	Free	Free	Free	3%
7804.20.20	Alloyed powders; flakes	2.5%	Free	Free	Free	Free	3%
7805.00	Lead tubes, pipes, and tube or pipe fittings	3%	Free	Free	Free	5%	3%
7806.00	Other articles of lead	3%	Free	Free	Free	Free to 5%	3%

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002); *Customs Tariff Schedules of Japan*, 2003.
(1) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, LEAD PRODUCTION AND TRADE, 2001 AND 2002, AND USE, 2000 AND 2001

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS					
	New Brunswick	82 368	59 964	73 250	52 301
	British Columbia	35 278	25 682	2 283	1 630
	Nunavut	32 743	23 837	23 523	16 795
	Total	150 389	109 483	99 056	70 726
	Mine output (2)	153 932	. .	97 283	. .
	Refined production				
	Primary	127 007	. .	133 815	. .
	Recycled	103 921	. .	118 005	. .
	Total	230 928	. .	251 820	. .
EXPORTS					
2603.00.20	Lead content of copper ores and concentrates	–	–	–	–
2607.00	Lead ores and concentrates				
	Germany	10 600	7 860	22 807	15 064
	China	15 049	7 575	11 495	6 520
	Belgium	4 792	2 454	8 003	5 870
	Sweden	23 384	16 597	–	–
	Italy	4 368	2 320	–	–
	Total	58 193	36 806	42 305	27 454
2607.00.20	Lead content of lead ores and concentrates	58 163	32 809	42 271	22 762
2608.00.20	Lead content of zinc ores and concentrates	10 929	3 458	10 912	3 613
2616.10.20	Lead content of silver ores and concentrates	–	–	–	–
7801.10	Unwrought lead				
	Refined lead				
	United States	123 586	104 485	134 752	108 847
	Taiwan	–	–	293	198
	Japan	116	166	61	87
	Malaysia	71	61	80	70
	Other countries	1 604	1 120	–	–
	Total	125 377	105 832	135 186	109 202
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	18 225	18 234	20 348	17 065
7801.99	Lead, unwrought, n.e.s.	28 775	26 603	32 125	26 758
7802.00	Lead waste and scrap				
	United States	1 632	729	352	369
	Other countries	–	–	49	31
	Total	1 632	729	401	400
7803.00	Lead bars, rods, profiles and wire				
	United States	308	490	416	537
	Other countries	–	–	15	62
	Total	308	490	431	599
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	–	–	2	8

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7804.19	Lead plates, sheet, strip and foil, n.e.s.	877	1 199	1 453	2 136
7804.20	Lead powders and flakes	89	113	100	135
7805.00	Lead tubes, pipes, and tube or pipe fittings (i.e., couplings, elbows, sleeves)	8	28	30	73
7806.00	Other articles of lead				
	United States	. .	5 902	. .	5 592
	Other countries	. .	48	. .	41
	Total	. .	5 950	. .	5 633
	Total exports	. .	232 251	. .	215 838
IMPORTS (3)					
2603.00.00.20	Lead content of copper ores and concentrates	–	–	–	–
2607.00	Lead ores and concentrates				
	Peru	28 374	39 120	44 878	59 557
	United States	23 477	58 579	13 558	46 949
	Australia	–	–	4 201	12 018
	Chile	3 079	3 859	17	3 936
	Morocco	1 579	2 273	6 532	1 958
	Honduras	16	2 793	2 017	1 775
	Other countries	1 299	4 225	20	1 264
	Total	57 824	110 849	71 223	127 457
2607.00.00.20	Lead content of lead ores and concentrates	52 652	63 520	68 361	69 379
2608.00.00.20	Lead content of zinc ores and concentrates	2 376	2 153	298	305
2616.10.00.20	Lead content of silver ores and concentrates	3 186	1 767	194	61
7801.10.10	Unwrought lead	975	834	1 422	1 407
	Refined lead, pig and block				
7801.10.90	Refined lead, other	2 349	6 762	372	419
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	184	215	15	20
7801.99	Lead, unwrought, other	495	1 770	311	481
7802.00	Lead waste and scrap				
	United States	54 956	11 882	41 058	7 354
	Other countries	221	102	358	108
	Total	55 177	11 984	41 416	7 462
7803.00	Lead bars, rods, profiles and wire				
	United States	842	1 354	1 253	2 136
	Other countries	275	498	15	29
	Total	1 117	1 852	1 268	2 165
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	396	429	289	345
7804.19	Lead plates, sheet, strip and foil, n.e.s.	202	294	186	260
7804.20	Lead powders and flakes	71	136	79	145

TABLE 1 (cont'd)

Item No.		2001 (tonnes)	2001 ($000)	2002 (p) (tonnes)	2002 (p) ($000)
IMPORTS (3) (cont'd)					
7805.00	Lead tubes, pipes, and tube or pipe fittings (i.e., couplings, elbows, sleeves)	18	30	15	27
7806.00	Other articles of lead				
	United States	4 051	5 418	3 329	4 837
	Japan	371	467	567	733
	France	166	173	106	167
	Germany	135	126	164	162
	Other countries	395	517	93	117
	Total	5 118	6 701	4 259	6 016
	Total imports	182 140	209 296	189 708	215 949

	2000			2001 (p)		
	Primary	**Recycled** (5)	**Total**	**Primary**	**Recycled** (5)	**Total**
QUANTITY USED (4)						
Lead used for or in the production of:						
Antimonial lead	x	x	x	x	x	x
Batteries and battery oxides	13 286	12 915	26 201	x	x	x
Chemical uses: white lead, red lead, litharge, tetraethyl lead, etc.	x	x	x	x	x	x
Copper alloys: brass, bronze, etc.	14	13	27	12	8	20
Lead alloys:						
Solders	273	1 184	1 457	x	x	x
Others (including babbitt, type metals, etc.)	x	x	x	x	x	x
Semi-finished products:						
Pipe, sheet, traps, bends, blocks for caulking, ammunition, etc.	2 428	195	2 624	x	x	x
Other lead products	2 014	1 809	3 823	3 201	1 695	4 896
Total, all categories	30 146	51 219	81 365	23 009	33 947	56 956

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; n.e.s. Not elsewhere specified; (p) Preliminary; x Confidential.
(1) Production includes recoverable lead in ores and concentrates shipped valued at the Montréal Exchange average price for the year.
(2) Lead content of domestic ores and concentrates exported. (3) Imports from "other countries" may include re-imports from Canada.
(4) Available data, as reported by users. (5) Includes all remelt scrap lead used to make antimonial lead.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, LEAD PRODUCTION, TRADE AND USE, 1975, 1980 AND 1985-2002

	Production				Exports (1)			Imports	Quantity Used (3)
		Refined							
	All Forms (2)	Primary	Recycled	Total	In Ores and Concentrates	Refined	Total	Refined	
					(tonnes)				
1975	349 133	171 516	. .	171 516	211 909	110 882	322 791	(a) 1 962	89 192
1980	251 627	162 463	72 117	234 580	147 008	126 539	273 547	(a) 2 602	106 836
1985	268 291	173 220	66 791	240 011	93 657	113 993	207 650	(a) 5 675	104 447
1986	334 342	169 934	87 746	257 680	118 373	111 831	230 204	(a) 4 247	94 680
1987	373 215	139 475	91 186	230 661	207 936	100 204	308 140	(a) 12 558	97 281
1988	351 148	179 461	88 615	268 076	200 822	179 946	380 768	15 132	88 728
1989	268 887	157 330	85 515	242 845	170 582	121 444	292 026	11 734	88 408
1990	233 372	87 180	96 465	183 645	221 566	84 007	305 573	11 781	72 203
1991	248 102	106 420	105 946	212 366	175 150	86 631	261 781	7 553	80 253
1992	339 626	151 252	101 633	252 885	190 822	131 546	322 368	8 289	92 420
1993	183 105	147 907	69 107	217 014	96 428	124 610	221 038	11 612	91 915
1994	167 584	153 035	98 605	251 640	55 923	133 203	189 126	5 119	95 764
1995	204 227	178 019	103 372	281 391	90 254	140 478	230 732	3 967	91 171
1996	241 751	192 877	117 914	310 791	154 697	159 860	314 557	4 179	93 373
1997	170 847	139 736	131 659	271 395	112 694	155 639	268 333	5 843	92 997
1998	150 019	129 750	135 737	265 487	52 250	145 358	197 608	6 458	87 466
1999	155 369	148 526	117 889	266 415	58 831	139 622	198 453	7 663	92 557
2000	143 303	159 192	125 141	284 833	50 900	148 428	199 328	7 028	81 365
2001	150 389	127 007	103 921	230 928	69 092	126 652	195 744	(r) 5110	56 956
2002 (p)	99 056	133 815	118 005	251 820	53 183	137 070	190 253	3 616	. .

Sources: Natural Resources Canada; Statistics Canada.
. . Not available; (p) Preliminary; (r) Revised.
(a) Lead in pigs, blocks and shot.
(1) Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2603.00.20, 2607.00.20, 2608.00.20 and 2616.10.20. Refined exports include HS classes 7801.10, 7803.00, 7804.11, 7804.19 and 7804.20. Refined imports include HS classes 7801.10.10, 7801.10.90, 7803.00, 7804.11, 7804.19 and 7804.20.
(2) Recoverable lead in ores and concentrates shipped. (3) Primary and recycled in origin, as measured by a survey of users.

TABLE 3. ANNUAL AVERAGE LEAD PRICES, 1975-2002

	London Metal Exchange			
	Settlement		Three Months	
	(US$/t)	(USc/lb)	(US$/t)	(USc/lb)
1975	413.48	18.75	441.93	18.82
1976	451.51	20.48	469.03	21.28
1977	617.78	28.02	626.84	28.43
1978	658.87	29.89	659.07	29.90
1979	1 203.15	54.57	1 149.95	52.16
1980	909.12	41.24	911.46	41.34
1981	734.73	33.33	750.12	34.03
1982	544.08	24.68	562.53	25.52
1983	425.27	19.29	440.55	19.98
1984	444.36	20.16	445.25	20.20
1985	394.10	17.88	394.12	17.88
1986	406.89	18.46	407.26	18.47
1987	597.41	27.10	567.38	25.74
1988	655.83	29.75	635.68	28.83
1989	676.14	30.67	659.36	29.91
1990	817.85	37.10	790.82	35.87
1991	557.84	25.30	568.90	25.81
1992	540.04	24.50	553.56	25.11
1993	406.38	18.43	420.36	19.07
1994	549.01	24.90	564.10	25.59
1995	630.51	28.60	638.88	28.98
1996	773.96	35.11	771.22	34.98
1997	624.08	28.31	633.01	28.71
1998	528.42	23.97	533.29	24.19
1999	502.24	22.78	508.89	23.08
2000	454.22	20.60	468.07	21.23
2001	476.04	21.59	483.24	21.92
2002	452.52	20.53	461.65	20.94

Source: International Lead and Zinc Study Group.

TABLE 4. LME MONTHLY AVERAGE LEAD PRICES, 2001 AND 2002

	London Metal Exchange			
	Settlement		Three Months	
	(US$/t)	(USc/lb)	(US$/t)	(USc/lb)
2001				
January	478.05	21.68	488.84	21.17
February	501.80	22.76	500.63	22.71
March	498.39	22.61	503.50	22.84
April	477.50	21.66	489.63	22.21
May	466.69	21.17	478.74	21.72
June	444.14	20.15	456.14	20.69
July	461.55	20.94	470.39	22.34
August	482.95	21.91	491.16	22.28
September	465.25	21.10	475.45	21.57
October	468.11	21.23	477.78	21.67
November	486.48	22.07	485.57	22.03
December	483.26	21.92	481.15	21.82
2002				
January	512.43	23.24	509.91	23.13
February	479.95	21.77	489.25	22.19
March	480.15	21.78	492.42	22.34
April	472.36	21.43	484.67	21.98
May	451.89	20.50	463.61	21.03
June	440.00	19.96	451.86	20.50
July	446.13	20.24	456.52	20.71
August	423.24	19.20	432.67	19.63
September	421.26	19.11	430.50	19.53
October	418.15	18.97	428.80	19.45
November	442.12	20.05	449.05	20.37
December	443.61	20.12	452.26	20.51

Source: International Lead and Zinc Study Group.

TABLE 5. MINE PRODUCTION OF LEAD, BY COUNTRY, 1998-2002

	1998	1999	2000	2001	2002 (p)
			(000 t)		
EUROPE					
Bulgaria	22	14	14	16	24
Greece	23	19	16	27	29
Ireland	36	39	57	45	32
Italy	6	5	3	4	4
Macedonia	30	27	24	24	24
Poland	60	63	51	53	45
Romania	15	18	19	20	17
Russia	13	14	14	14	19
Spain	19	29	51	36	6
Sweden	112	118	107	88	44
Serbia and Montenegro	16	9	4	5	5
Other Europe	5	–	–	–	–
Total Europe	357	355	360	330	249
AFRICA					
Morocco	80	80	82	77	73
Namibia	14	12	12	12	12
South Africa	84	80	75	51	50
Other Africa	4	8	8	8	7
Total Africa	182	179	178	149	142
AMERICAS					
Canada	190	162	149	154	97
Mexico	166	126	138	136	140
Peru	258	271	271	289	291
United States	491	513	458	463	448
Other Americas	180	39	37	38	41
Total Americas	1 146	1 111	1 053	1 080	1 017
ASIA					
China	581	549	660	599	568
India	38	38	36	32	35
Iran	17	17	17	18	17
Japan	6	6	9	5	6
Kazakhstan	26	31	39	43	43
North Korea	30	16	12	9	6
Thailand	7	12	11	–	3
Turkey	12	14	17	16	14
Other Asia	9	5	5	4	2
Total Asia	726	688	806	726	694
OCEANIA					
Australia	584	633	650	714	658
Total Western World	2 246	2 261	2 245	2 237	2 038
Total World	2 995	2 966	3 047	3 005	2 760

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
– Nil; (p) Preliminary.

TABLE 6. REFINED LEAD PRODUCTION, BY COUNTRY, 1998-2002

	1998	1999	2000	2001	2002 (p)
			(000 t)		
EUROPE					
Belgium	92	110	119	100	88
Bulgaria	77	82	84	83	66
Czech Republic	24	25	28	30	29
France	289	273	262	230	203
Germany	353	353	387	375	378
Italy	199	215	231	222	193
Poland	64	64	56	58	50
Russia	36	44	32	58	63
Spain	94	98	120	122	125
Sweden	87	79	78	75	65
United Kingdom	370	372	338	382	368
Other Europe	167	140	147	146	137
Total Europe	1 852	1 855	1 882	1 889	1 765
AFRICA					
Morocco	62	65	67	58	65
South Africa	50	52	46	55	61
Other Africa	15	14	12	12	11
Total Africa	127	131	125	125	137
AMERICAS					
Brazil	48	52	50	47	47
Canada	266	266	284	231	251
Mexico	259	199	241	234	232
Peru	104	111	116	118	121
United States	1 436	1 447	1 457	1 376	1 359
Other Americas	69	60	67	64	72
Total Americas	2 182	2 136	2 215	2 070	2 082
ASIA					
China	757	918	1 100	1 172	1 288
India	66	64	67	63	78
Japan	302	293	312	302	280
Kazakhstan	92	159	208	159	166
Malaysia	29	33	32	38	40
North Korea	25	14	10	7	5
South Korea	180	190	220	211	230
Taiwan	39	53	55	62	55
Other Asia	163	158	159	171	176
Total Asia	1 648	1 882	2 163	2 185	2 318
OCEANIA					
Australia	200	271	259	271	302
New Zealand	6	6	5	5	5
Total Oceania	206	277	263	276	307
Total Western World	4 911	4 945	5 093	4 929	4 902
Total World	6 015	6 280	649	6 545	6 609

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
(p) Preliminary.

TABLE 7. REFINED LEAD USE, BY COUNTRY, 1998-2002

	1998	1999	2000	2001	2002 (p)
			(000 t)		
EUROPE					
Austria	67	55	61	59	60
Belgium	58	51	57	40	38
France	251	260	268	265	250
Germany	356	372	390	403	381
Ireland	26	30	29	34	42
Italy	262	279	279	284	286
Netherlands	51	30	29	30	30
Poland	59	60	52	59	54
Russia	92	95	83	94	111
Spain	188	192	231	246	240
United Kingdom	310	325	328	315	310
Other Europe	251	231	241	256	253
Total Europe	1 971	1 980	2 048	2 085	2 055
AFRICA					
Algeria	21	21	21	20	21
Egypt	8	8	9	9	9
South Africa	74	67	59	59	71
Other Africa	32	37	41	35	42
Total Africa	135	133	130	123	143
AMERICAS					
Brazil	110	108	114	112	112
Canada	67	70	68	55	58
Mexico	163	187	195	192	225
United States	1 742	1 793	1 791	1 694	1 653
Other Americas	116	105	113	94	103
Total Americas	2 198	2 263	2 281	2 147	2 061
ASIA					
China	505	524	590	700	860
India	95	112	119	127	130
Indonesia	53	45	66	48	61
Iran	64	65	68	70	68
Japan	308	289	301	284	252
Malaysia	62	76	84	82	86
South Korea	236	272	303	314	330
Taiwan	132	150	170	167	154
Thailand	46	66	96	82	111
Other Asia	179	196	207	210	214
Total Asia	1 681	1 796	2 004	2 084	2 266
OCEANIA					
Australia	54	56	41	41	39
New Zealand	10	6	5	5	6
Total Oceania	64	62	46	47	44
Total Western World	5 259	5 419	5 623	51	5 364
Total World	6 034	6 235	6 508	6 485	6 569

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
(p) Preliminary.

TABLE 8. WESTERN WORLD RECOVERY OF RECYCLED(1) LEAD, 1998-2002

	1998	1999	2000	2001	2002 (p)
			(000 t)		
EUROPE					
Austria	23	24	23	22	21
Belgium	33	77	107	100	88
France	158	150	137	132	121
Germany	192	192	216	218	237
Ireland	13	11	9	10	7
Italy	142	148	163	164	152
Netherlands	17	18	21	20	18
Spain	94	98	120	122	116
Sweden	48	44	47	44	47
United Kingdom	184	183	182	183	175
Other Europe	39	42	38	38	37
Total Europe	943	987	1 063	1 053	1 019
AFRICA					
Algeria	6	6	6	6	6
Morocco	4	6	4	4	4
South Africa	50	52	46	49	61
Other Africa	9	7	6	5	5
Total Africa	69	71	62	64	76
AMERICAS					
Brazil	48	52	50	47	42
Canada	136	118	125	104	117
Mexico	87	91	79	92	106
United States	1 099	1 097	1 115	1 086	1 099
Other Americas	68	60	60	55	62
Total Americas	1 438	1 418	1 429	1 384	1 426
ASIA					
India	17	19	25	19	35
Indonesia	22	18	18	18	17
Iran	26	28	28	28	30
Japan	158	168	182	175	173
Malaysia	29	33	32	38	40
South Korea	47	57	66	63	69
Taiwan	39	53	55	62	55
Thailand	19	23	24	28	40
Other Asia	69	70	70	76	75
Total Asia	426	469	500	507	534
OCEANIA					
Australia	28	32	34	34	34
New Zealand	6	6	5	5	5
Total Oceania	34	37	38	39	39
Total Western World	2 910	2 983	3 093	3 048	3 093

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
(p) Preliminary.
(1) Refined lead and lead alloys (lead content) produced from scraps, wastes and residues.

Lime

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"Lime" is a general term referring to burned or calcined limestone (burnt lime or quicklime) and its secondary products, including hydrated lime (calcium hydroxide), also referred to as slaked lime. In the calcining process, quicklime (CaO or CaO.MgO) begins to form at the dissociation temperature of limestone. Temperatures are maintained sufficiently long until there is a complete breakdown of the limestone and a release of the carbon dioxide content. High-calcium quicklime containing mainly CaO and less than 5% MgO is the most common type of lime produced. However, dolomitic quicklime (or dolime) and its hydrated products are also produced; these products contain 35-40% MgO.

CANADIAN INDUSTRY

Canadian shipments of all lime in 2002 amounted to 2.24 Mt valued at $220 million based on preliminary data. These amounts are marginally higher than the previous year (Tables 1 and 2). Quicklime accounted for about 90% of the total volume and value of shipments. Production figures do not include some captive production from pulp and paper plants that burn sludge to recover lime for re-use in the causticization process. Similarly, beginning with 1996 data, General Chemical Canada Ltd. has not been included in the production figures because this company's output, in some cases, is related to the manufacture of derived chemicals.

The lime industry in Canada comprises 15 operating plants from New Brunswick to British Columbia as of year-end 2002 (Figure 1 and Table 3). The Haileybury plant in Ontario, owned by Miller Minerals, a division of Miller Paving Limited, remained closed in 2002. Total employment by the merchant producers in 2001 (the most recent year for which Statistics Canada data are available) was approximately 699, compared to 843 in 2000 and 765 in 1999.

The Graymont group of companies, with eight plants across Canada and several plants in the United States, now accounts for an estimated 30% of total lime capacity in North America. Carmeuse North America Group, with complete or partial ownership of three plants in Ontario, is the leading producer of lime in North America. Chemical Lime Company of Canada Inc., with one operation in British Columbia, is the second largest lime producer in North America.

USE

The types or forms of lime commercially available are essentially the same as reported in detail in the chapter on Lime that appeared in the 1998 edition of the *Canadian Minerals Yearbook*.

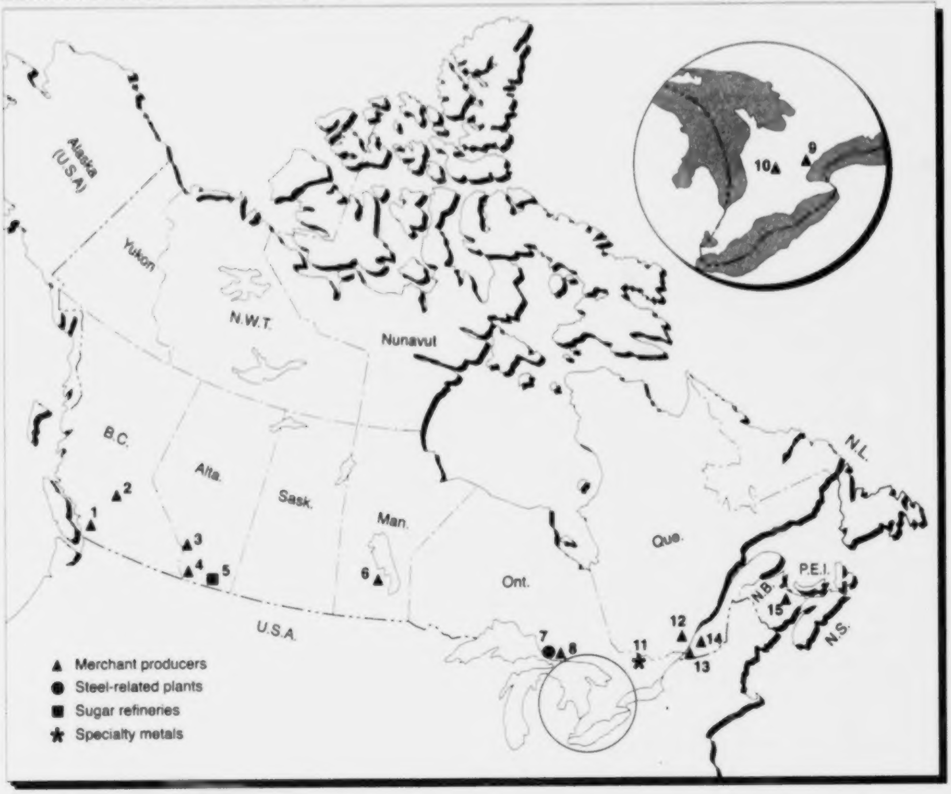
The use of lime in Canada, or essentially its complete consumption in the manufacture of numerous products, relates mainly to the merchant market, which is served by the mainstream lime producers.

The use of quicklime, based on reported shipments for the merchant market, amounted to 1 522 451 t in 2002, compared to 1 308 095 t (revised) in 2001. The major end uses for quicklime in 2002 were steel-making (48%), environmental control (12%), pulp and paper (16%), chemicals (11%), and other industrial uses, including metal concentration (13%). Hydrated lime shipments in the merchant market amounted to 165 694 t in 2002, compared to 139 605 t (revised) in 2001. The major uses for this lime in 2002 were environmental control (64%), other industrial uses (22%), agricultural uses (2%), and other miscellaneous uses related mainly to road and soil stabilization and other construction and masonry (12%).

ENERGY AND TECHNOLOGY

Energy costs to produce quicklime account for about 40% of total production costs, one of the highest ratios in the

Figure 1
Lime Producers in Canada, 2002


Alaska (U.S.A)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
N.L.
P.E.I.
N.B.
N.S.
U.S.A.
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11
12
13
14
15
▲ Merchant producers
● Steel-related plants
■ Sugar refineries
★ Specialty metals

Numbers refer to locations on map above.

Merchant Producers

1. Chemical Lime Company of Canada Inc., Fort Langley
2. Graymont Western Canada Inc., Pavilion Lake
3. Graymont Western Canada Inc., Exshaw
4. Graymont Western Canada Inc., Summit plant, Hazell[1]
6. Graymont Western Canada Inc., Faulkner
8. Carmeuse North America Group, Spragge
9. Lafarge Lime (Canada) Inc., Dundas Division
10. Carmeuse North America Group, Ingersoll
12. Graymont (QC) Inc., Joliette
13. Graymont (QC) Inc., Bedford
14. Graymont (QC) Inc., Marbleton
15. Graymont (NB) Inc., Havelock

Steel-Related Producers

7. Algoma Steel Inc., Sault Ste. Marie

Sugar Refineries

5. Rogers Sugar Ltd., Taber

Specialty Metals

11. Timminco Limited, Haley Station

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[1] Plant remained closed in 2002.

mineral-processing sector. Calcining of limestone and/or dolomitic limestone takes place mainly in vertical (shaft-type) kilns or rotary-type kilns, the latter technology being most common in North America. Preheater systems and computerized process control systems are now commonplace.

About 50% of the kilns in service in Canada use natural gas, with petroleum coke, coal and heating oils accounting for the energy inputs required for the calcining process. Kiln efficiencies depend on the type of design and generally range from 4 to 5 gigajoules per tonne (GJ/t) of calcined lime for shaft kilns to as much as 13 GJ/t for long rotary kilns not equipped with preheaters. About 60% of carbon dioxide emissions relate to the decomposition of limestone; however, these process emissions vary considerably depending upon the chemical composition of the limestones used. Most of the remaining emissions are accounted for by fuel needs.

PRICES

The actual prices for lime products vary according to marketing strategies and supply and demand. The average reported values f.o.b. plant for quicklime and hydrated lime, based on producers' shipments as listed in Table 1, were $96.50/t and $121/t, respectively, in 2002.

INTERNATIONAL DEVELOPMENTS

World lime production was an estimated 116 Mt in 2002, compared to 118 Mt in 2001 (Table 5). China and the United States, accounting for 23 Mt and 18 Mt, respectively, were followed by Russia, Japan and Germany with 8.0 Mt, 7.5 Mt and 7.0 Mt, respectively.

Canada ranks in the top 10 lime-producing countries because of relatively large chemical and industrial requirements, according to the final 2001 information. Reserves of limestone and related non-renewable mineral/rock resources are relatively large; however, land-use constraints in some regions are becoming more onerous. The proximity of lime plants to U.S. markets has resulted in a favourable balance of trade in lime products throughout the period 1980-2002, as shown in Table 2.

The United States produced 18.4 Mt of lime in 2002, compared to 18.9 Mt in 2001, according to preliminary figures. Apparent use amounted to 18.5 Mt in 2002 compared to 19.0 Mt in 2001. Environmental uses for lime in the United States, which include flue gas sulphur removal, water treatment and waste-water treatment, have grown rapidly and are the third most important uses after metallurgical, chemical and industrial uses.

OUTLOOK

The production of lime in Canada in 2003 is expected to decline moderately based on lower mid-year shipments of 3% and weaker markets for domestic steel. However, the demand for lime by pulp and paper producers and by other consumers is expected to remain firm.

Lime is now marketed to several industries more as a specialty chemical than as a commodity because certain uses demand stricter specifications relating to ISO standards. In particular, these standards may apply to: 1) lime and dolime for steel-making; 2) the processing of lime for precipitated calcium carbonate (PCC) for a range of industrial uses; 3) lime for flue-gas desulphurization technology to make commercial-quality synthetic (FGD) gypsum; and 4) high-purity lime for water treatment. The use of lime in the environmental sector is expected to increase in the short term given the importance of treating effluents in the industrial and mining sectors.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
2522.10	Quicklime	Free	Free	Free	Free
2522.20	Slaked lime	Free	Free	Free	Free
2522.30	Hydraulic lime	Free	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003.

TABLE 1. CANADA, LIME PRODUCTION AND TRADE, 2001 AND 2002

Item No.		2001		2002(p)	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (1)					
	By type				
	Quicklime	2 007 078	189 672	2 045 017	197 210
	Hydrated lime	205 568	24 159	192 261	23 253
	Total	2 212 646	213 831	2 237 278	220 463
	By province				
	New Brunswick	x	x	x	x
	Quebec	x	x	x	x
	Ontario	1 066 204	96 746	1 117 716	103 876
	Manitoba	x	x	x	x
	Alberta	x	x	x	x
	British Columbia	x	x	x	x
	Total	2 212 646	213 831	2 237 278	220 463
IMPORTS (2)					
2518.20	Calcined dolomite				
	United States	19 436	2 683	46 590	6 936
	Italy	–	–	25	18
	Total	19 436	2 683	46 615	6 954
2522.10	Quicklime				
	United States	75 610	8 475	55 474	6 745
	United Kingdom	71	11	406	70
	Switzerland	219	28	100	18
	Canada	27	3	18	3
	India	11	2	6	1
	Finland	–	–	–	–
	Total	75 938	8 519	56 004	6 837
2522.20	Slaked lime				
	United States	5 548	1 281	5 459	1 281
	Germany	–	–	5	2
	France	–	–	1	–
	Belgium	–	–	–	–
	Japan	–	–	–	–
	United Kingdom	2	1	–	–
	Total	5 550	1 282	5 465	1 283
2522.30	Hydraulic lime				
	United States	12 661	2 000	8 505	1 479
	France	–	–	289	95
	Germany	2	1	5	2
	United Kingdom	–	–	1	–
	Belgium	–	–	–	–
	Italy	–	–	–	–
	Jordan	–	–	–	–
	Total	12 663	2 001	8 800	1 576

TABLE 1 (cont'd)

Item No.		2001		2002(p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
2518.20	Calcined dolomite				
	United States	11 134	4 648	9 785	1 214
2522.10	Quicklime				
	United States	87 588	14 297	113 458	22 395
2522.20	Slaked lime				
	United States	5 836	966	6 374	969
	France	2	1	2	1
	Total	5 838	967	6 376	970
2522.30	Hydraulic lime				
	United States	59	42	162	61
	China	31	14	66	31
	Total	90	56	228	92

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.
(1) Producers' shipments and quantities used by producers. (2) Includes re-imports.
Notes: Numbers may not add to totals due to rounding. HS code 2522.30, as interpreted, applies mainly to hydrated lime.

TABLE 2. CANADA, LIME PRODUCTION, TRADE AND APPARENT USE, 1980 AND 1985-2002

	Production (1)					Apparent
	Quick	Hydrated	Total	Imports	Exports	Use (2)
			(tonnes)			
1980	2 364 000	190 000	2 554 000	40 901	403 166	2 191 735
1985	2 054 294	157 286	2 211 580	23 056	194 097	2 040 539
1986	2 069 043	173 534	2 242 577	46 917	189 512	2 099 982
1987	2 140 793	189 278	2 330 071	44 290	163 767	2 210 594
1988 (a)	2 306 831	211 151	2 517 982	32 543	122 900	2 427 625
1989	2 349 312	202 622	2 551 934	39 095	83 608	2 507 421
1990	2 137 996	202 741	2 340 737	43 715	138 409	2 246 043
1991	2 184 836	190 424	2 375 260	45 012	134 405	2 285 867
1992	2 193 752	190 592	2 384 344	55 706	173 248	2 266 802
1993	2 186 749	192 247	2 378 996	52 690	190 068	2 241 618
1994	2 250 205	198 818	2 449 023	66 886	193 902	2 322 007
1995	2 244 800	216 916	2 461 716	52 884	266 475	2 248 125
1996	2 134 437	267 595	2 402 032	36 639	216 849	2 221 822
1997	2 219 385	257 186	2 476 571	47 382	224 232	2 299 721
1998	2 204 957	256 086	2 461 043	(r) 34 031	171 446	(r) 2 323 628
1999	2 299 705	265 746	2 565 451	54 535	96 058	2 523 928
2000	2 271 277	254 092	2 525 369	62 296	80 631	2 507 034
2001	2 007 078	205 568	2 212 646	94 151	93 516	2 213 281
2002 (p)	2 045 017	192 261	2 237 278	70 269	120 062	2 187 485

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary; (r) Revised.
(a) Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and exports include HS classes 2522.10, 2522.20 and 2522.30.
(1) Producers' shipments and quantities used by producers. (2) Production plus imports, less exports.

TABLE 3. CANADIAN LIME INDUSTRY, 2002

Company	Plant Location	Calcining Capacity	Market	Type of Quicklime and Other Products
		(000 t/y)		
NEW BRUNSWICK				
Graymont (NB) Inc.	Havelock	175	Merchant	High-calcium (1)
QUEBEC				
Graymont (QC) Inc.	Marbleton	330	Merchant	High-calcium (1)
Graymont (QC) Inc.	Joliette	200	Merchant/captive	High-calcium (1)
Graymont (QC) Inc.	Bedford	200	Merchant	High-calcium
ONTARIO				
Algoma Steel Inc.	Sault Ste. Marie	200	Captive	High-calcium and dolomitic
Beachville Lime Limited	Ingersoll	600	Merchant	High-calcium (1) and dolomitic
Northern Lime Limited	Spragge	200	Merchant	High-calcium and dolomitic
Lafarge Lime (Canada) Inc., Dundas Division	Dundas	345	Merchant	High-calcium and dolomitic
Timminco Limited	Haley Station	53	Captive	Dolomitic
MANITOBA				
Graymont Western Canada Inc.	Faulkner	117	Merchant	High-calcium
ALBERTA				
Rogers Sugar Ltd.	Taber	66	Captive	High-calcium
Graymont Western Canada Inc.	Exshaw	180	Merchant	High-calcium (1)
Graymont Western Canada Inc., Summit plant	Hazell	50	Merchant	High-calcium and dolomitic (1)
BRITISH COLUMBIA				
Graymont Western Canada Inc.	Pavilion Lake	235	Merchant	High-calcium
Chemical Lime Company of Canada Inc.	Fort Langley	135	Merchant	High-calcium (1)

Source: Natural Resources Canada.
(1) Production of hydrated lime.
Note: Lantic Sugar Limited operates sugar refineries in Quebec and New Brunswick.

TABLE 4. CANADA, USE(1) OF DOMESTIC LIME, QUICK AND HYDRATED, 1998-2002

End Uses	1998	1999	2000	2001	2002
			(tonnes)		
CHEMICAL AND INDUSTRIAL					
Steel-making	707 482	780 877	632 284	530 605	730 180
Water and sewage treatment	310 510	296 053	224 074	197 817	233 036
Water purification	48 366	51 323	37 445	48 420	38 590
Gas scrubbing	15 060	16 309	7 629	6 742	22 803
Metal concentration	158 482	138 431	153 469	176 213	141 434
Pulp and paper mills	200 824	213 627	218 878	253 287	240 646
Chemicals	193 693	194 362	161 408	163 070	167 952
Other industrial uses	96 416	101 102	109 645	44 765	88 500
CONSTRUCTION					
Road and soil stabilization	14 323	15 810	9 586	11 159	10 408
Mason and finishing lime	1 684	1 591	917	8 757	7 550
Other	17 807	22 126	11 259	3 096	3 754
AGRICULTURE	1 051	2 512	4 699	3 791	3 292
Total use	1 765 697	1 834 124	1 571 293	1 447 722	1 688 145

Source: Natural Resources Canada, based on producing companies' surveys, 1998-2002.
(1) Includes merchant market only; excludes companies that are completely captive producers/users.

TABLE 5. WORLD PRODUCTION OF QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE SOLD AND USED, 1998-2002

	1998	1999	2000	2001	2002 (p)
			(000 tonnes)		
Canada	2 460	2 570	2 500	2 210	2 237
Brazil	5 700	5 700	5 700	6 300	6 300
China	21 000	21 500	21 500	22 000	23 000
France	2 800	2 400	2 400	2 400	2 400
Germany	7 600	7 600	7 600	7 000	7 000
Italy (1)	3 500	3 500	3 500	3 500	3 500
Japan (2)	8 100	7 750	7 700	8 100	7 500
Mexico	6 600	6 600	6 600	6 500	6 500
Poland	2 500	2 500	2 500	2 200	2 200
Russia	(3)	(3)	(3)	8 000	8 000
United	2 500	2 500	2 500	2 500	2 500
United States	20 100	19 600	19 600	18 900	18 400
Other countries	33 050	33 650	33 995	28 056	26 500
Total	115 910	115 870	116 095	117 666	116 037

Sources: Natural Resources Canada; Statistics Canada; U.S. Geological Survey.
(p) Preliminary.
(1) Includes hydraulic lime. (2) Quicklime only. (3) Included with other countries.

Magnesium

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(Note: This is a brief review of magnesium metal projects related to Canada and is not intended to be a comprehensive global review.)

2002 exports:	$267 million
2002 imports:	$114 million

	1999	2000	2001	2002 (f)
		(tonnes)		
Primary metal production capacity (1,e)	49 000	50 500	59 500	70 000
Exports (HS 8401)	49 747	47 181	43 292	71 243
Imports (HS 8401)	38 377	34 586	33 478	34 943

(e) Estimated; (f) Forecast.
(1) Canadian magnesium production data are confidential due to the limited number of companies reporting. This number is based on published capacity for primary metal. Note that other published estimates of Canadian magnesium production include significant quantities of recycled material.

CANADIAN DEVELOPMENTS

Producers

Canadian production[1] capacity for primary magnesium metal will fall to approximately 54 000 t/y in 2003 as a result of the announced closure of Magnola Metallurgy Inc.'s Danville smelter. On a global basis, in 2002, Canada ranked second after China in magnesium production capacity. The value of Canadian exports of magnesium metal and metal products in 2002 was $267 million.

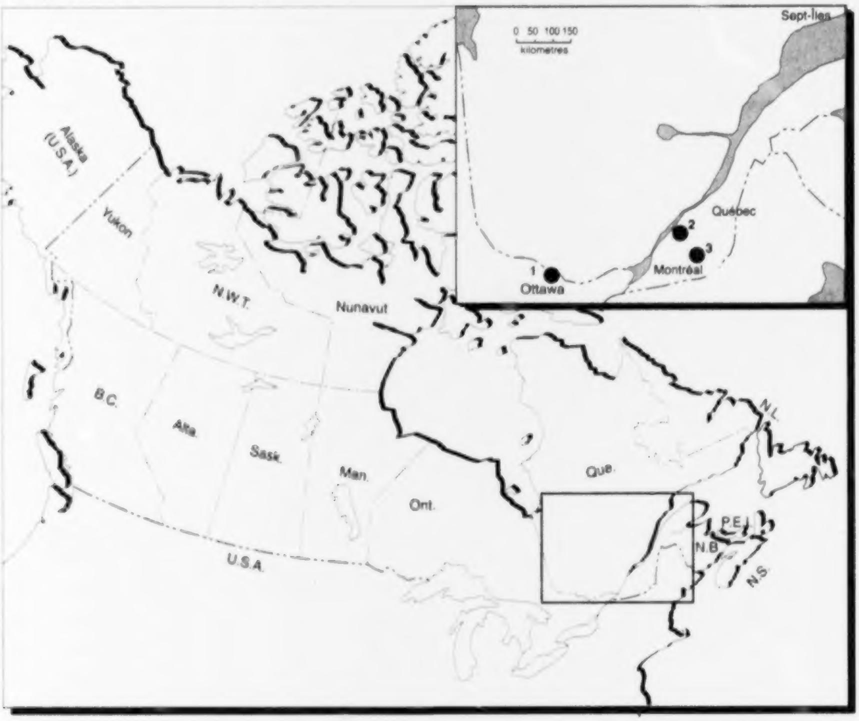
Magnola Metallurgy Inc. (owned 80% by Noranda Inc. and 20% by Société générale de financement du Québec) scheduled the closure of the 58 000-t/y magnesium metal plant at Danville, Quebec, for April 2003. The plant had a number of start-up problems but, by late 2002, many of the initial technical problems were reported to have been resolved. It was reported that the plant produced 24 648 t of magnesium in 2002 and that the company expected to reach full production in 2003. The company cited low magnesium prices as the reason for the closure and indicated that the price of magnesium needed to increase to the range of US$1.30/lb to financially justify resumption of the operation (www.norandamagnesium.com).

Norsk Hydro Canada Inc. (Norsk Hydro), a wholly owned subsidiary of Norsk Hydro ASA of Norway, has produced primary magnesium metal at a 48 000-t/y Bécancour, Quebec, plant using an electrolytic process since 1989. The plant also recycles magnesium scrap produced by its customers and has a recycling capacity of 10 000 t/y, but a portion of that facility was reported as operating at 75% of capacity in 2002 due to a shortage of scrap. The plant has been recently debottlenecked and future capacity increases at Bécancour will be based upon profitability. Norsk Hydro has been working on a series of new alloys for high-temperature applications and has started casting trials and testing as part of the work done by the European Council for Automotive Research and Development (EUCAR) (www.magnesium.hydro.com).

Timminco Limited operates a silicothermic reduction facility producing high-purity metal (up to 99.98% pure) for specialized markets at its 6000-t/y magnesium plant in Haley, Ontario. The operation includes a dolomitic limestone deposit and facilities for calcination, feed preparation, reduction, refining, and the casting of magnesium ingots and billets. Processing facilities include an extrusion and anode fabrication and assembly plant, as well as magnesium billet and slab processing facilities. The company also produces highly corrosion-resistant magnesium die-casting alloys and extruded anode rods for hot-water heaters. The casting facility at Haley provides magnesium billets for Timminco's extrusion facilities at Haley Station, Ontario, and Aurora, Colorado. On a longer-term basis, the company intended to expand operations in the wrought products area.

In 2002, Timminco completed work to develop dual-casting capability and ramped up the new Haley casthouse to commercial production levels. During the year, the company continued to restructure its operations and, in

Figure 1
Magnesium Smelters, 2002



Smelter	**Company**	**Capacity (t/y)**
1. Haley Station, Ontario	Timminco Limited	6 000
2. Bécancour, Quebec	Norsk Hydro Canada Inc.	48 000
3. Danville, Quebec	Magnola Metallurgy Inc.	58 000

February 2003, announced that Safeguard International Fund L.P. had agreed to purchase new and existing shares in the company after regulatory approval expected in April (www.timminco.com).

Metal Project Proposals

In Canada, as in the rest of the world, there has been a continued interest in the production of magnesium metal from dolomite and magnesite deposits or from previously mined asbestos deposits. The Canadian projects include: Globex Mining Enterprises Inc., a magnesite-talc project at Timmins, Ontario; Leader Mining International Inc., a project near Hope, British Columbia; Gossan Resources Ltd. at Inwood, Manitoba; Cassiar Resources Inc. at Cassiar, British Columbia; Canadian Magnesium Corporation at Baie Verte, Newfoundland and Labrador; and an asbestos-based project at Thetford Mines, Quebec.

Globex Mining Enterprises Inc. has continued work on its Timmins-area magnesium-talc deposit 13 km south of Timmins, Ontario. Previous work has indicated the potential for production of both magnesium metal and high-quality talc from the deposit. Results of a scoping study conducted by Hatch Associates of Canada in 2001 were positive and indicated a good economic potential using available technology. The project has the advantages of access to competitive power prices; ready access to large consumer markets; access to a stable, high-calibre work force; excellent infrastructure, including highways and railways; and a high-quality talc by-product to provide additional revenue. The company has worked on financing both the recommended full bankable feasibility study, with an expected cost of US$12 million, and a US$1.0 billion construction cost. The project would include a mine-mill complex located near Timmins, Ontario, and a 95 000-t/y smelter located in Quebec west of Rouyn-Noranda. Further details are available on the Internet at www.globexmining.com.

Leader Mining International Inc. acquired property in 2001 over the Cogburn ultramafic intrusive near Hope, British Columbia, which contains magnesium-bearing silicates. Scoping-level studies were undertaken in 2001 that indicated a capital cost estimate of US$1 billion for a mine and smelter with a production rate of 120 000 t/y. A definition diamond drilling program conducted in 2002 provided core samples for a composite sample for pilot scale testing. Other work has included initial work on environmental permitting, infrastructure studies, and bench-scale testing on composite samples. The company signed an agreement with the Ukraine State Research and Design Titanium Institute of Zaprozhye and the Russian National Aluminium and Magnesium Institute (VAMI) regarding the use of their technology on the project. A number of contractors, including Hatch Associates, were engaged to complete a study for a mine and a 120 000-t/y smelter project. Results were expected in 2003. Further details are available at www.leadermining.com.

Gossan Resources Ltd. maintained its interest in a dolomite property at Inwood, Manitoba. The company's dolomite resource is estimated at 67 Mt grading 21.6% MgO with additional inferred resources. Gossan indicates that the next phase of activity would be a drill program, which could in turn lead to a prefeasibility study. Tests on this material have shown that production of commercial-grade magnesium metal is possible using the Magnetherm process (www.gossan.ca).

The town of Thetford Mines, Quebec, worked on a prefeasibility study on a proposal to process mining residues from asbestos mines into magnesium metal. The town reports that more than 300 Mt of material with a grade of approximately 24% magnesium is available in the area for processing. Work continued to find and license a process that could be used to extract the magnesium. Discussions were also under way with possible partners in the project.

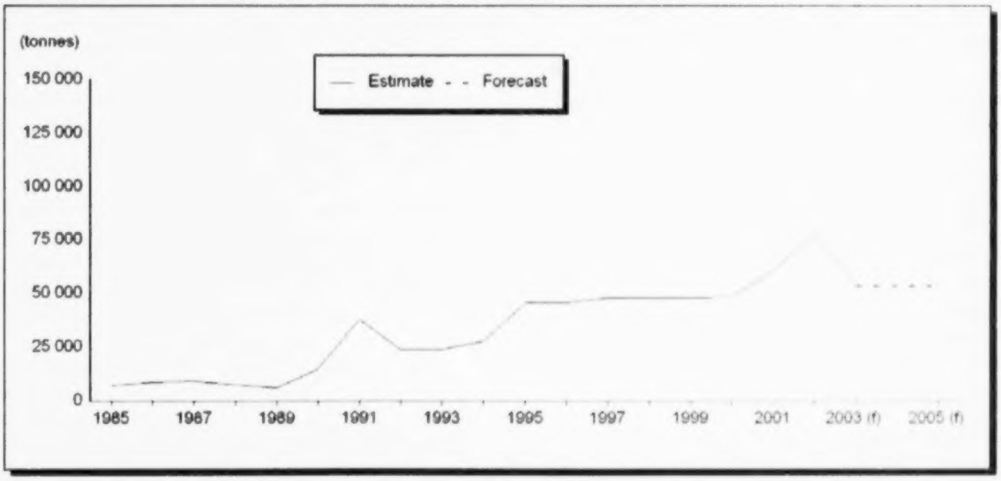
The Canadian Magnesium Corporation has proposed a project to extract magnesium oxide from serpentine in the tailings at the former Baie Verte asbestos mine in Newfoundland and Labrador. In 1999, CMC completed prefeasibility studies and bench-scale testing on mineral residues. Results of the work were positive and indicated that a clean product could be produced. The company continues to review its financing options prior to committing to piloting and marketing studies.

Cassiar Resources Inc. had a stockpile of 23 Mt of serpentine tailings that grade approximately 24% magnesium at the former Cassiar Asbestos Corporation Limited's mine at Cassiar in northern British Columbia. In 2002, the company continued to seek potential investors and decided not to actively pursue magnesium metal potential.[2]

Canadian Production and Use of Magnesium

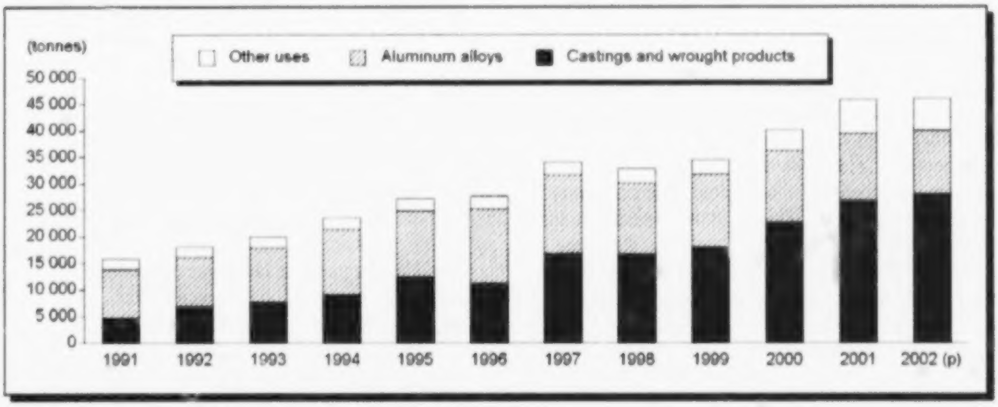
Canadian production capacity for magnesium (reported production for Magnola plus reported capacity for other smelters) was approximately 75 000 t/y in 2002, but with the closure of Magnola in 2003, capacity will fall to approximately 54 000 t/y in 2003.

Figure 2
Canadian Primary Magnesium Production Capacity, 1985-2005



Sources: Natural Resources Canada; published reports.
Note: Canadian production data are confidential due to the limited numbers of producers. This is the primary capacity or production reported of plants in Canada from credible published sources.

Figure 3
Canadian Use of Magnesium, 1991-2002



Source: Natural Resources Canada survey of Canadian users of magnesium
(p) Preliminary

In Canada, reported use of magnesium increased from a revised 40 154 t in 2000 to 45 840 t in 2001, due in part to an increased number of companies reporting.

GLOBAL CONTEXT

Production from many small companies in China continued to place pressure on magnesium producers around the world.

Following the closures in 2001 and early 2002 (refer to the chapter on Magnesium in the 2001 *Canadian Minerals Yearbook* at www.nrcan.gc.ca/mms/cmy/content/2001/36.pdf), Pechiney Électrométallurgie closed its 18 000-t/y Marignac magnesium smelter in France, but planned to continue operations at the site to recycle magnesium at a rate of about 5000 t/y. Further information is available on the Internet at www.pechiney.com.

Magnesium Corp. of America (Magcorp), after filing in 2001 for protection from its creditors under Chapter 11 of the bankruptcy code, was sold in 2002 to U.S. Magnesium LLC, another subsidiary of the Renco Group Inc. The company is modernizing equipment at its 43 000-t/y smelter in Rowley, Utah. Modernization of the plant is expected to eventually increase its capacity to 56 000 t/y, at which point it would be the company with the largest production capacity in the world.

The pressure from Chinese production also extended around the world, creating difficulties for exploration and for development projects, particularly those needing a large investment.

Magnesium Alloy Corporation continued work on developing its Kouilou project in the Republic of the Congo (Brazzaville). The company signed memoranda on evaluations of energy production and transmission and an off-take agreement for the purchase and marketing of up to all of the plant's production. The company has a web site at www.magnesiumalloy.ca.

PRICES

Prices published by *Metals Week* for magnesium trended slightly downward through the year. The U.S. Spot Western Mean started the year at US$1.25/lb and ended it at US$1.10/lb in December, while the mean U.S. dealer import prices decreased from US$1.07/lb early in the year to US$1.04/lb. The *Metal Bulletin*'s World Free Market Price for minimum 99.8% magnesium metal started the year at US$1775-$1875/t and increased to end the year at US$1880-$1980/t.

Reported prices of Chinese magnesium on a spot basis f.o.b. China started the year at approximately US$1200-$1300/t and strengthened but remained historically low throughout 2002. Spot sales were reported at US$1360-$1380/t at year-end.

Hydro Magnesium reduced its European producer price for magnesium alloy to 2.50/kg from 2.62/kg early in 2002. The company also announced that it would not continue to issue a European producer price for pure magnesium (www.magnesium.hydro.com).

ANNUAL AVERAGE PRICES, *METALS WEEK* (U.S. SPOT WESTERN MEAN)

1997	1998	1999	2000	2001	2002
		(US$/lb)			
1.65	1.59	1.55	1.37	1.25	1.21

Source: Calculated from data published in *Metals Week*.

STOCKS

International Magnesium Association (IMA) data indicate that reported inventories of primary magnesium decreased in 2002 to end the year at 18 834 t, down from 45 180 t at the end of 2001. This inventory does not include inventories in the Commonwealth of Independent States and China.

GENERAL INFORMATION ON MAGNESIUM

For recent statistics and events in the Canadian and global industry see:

- the magnesium chapter of the *Canadian Minerals Yearbook* at www.nrcan.gc.ca/mms/cmy/com_e.html;
- the *Nonferrous Metals Outlook* at www.nrcan.gc.ca/mms/pubs/nfo_e.htm;
- the web site of the International Magnesium Association at www.intlmag.org; and
- for other information, see the USGS web site at http://minerals.usgs.gov/minerals/pubs/commodity/magnesium.

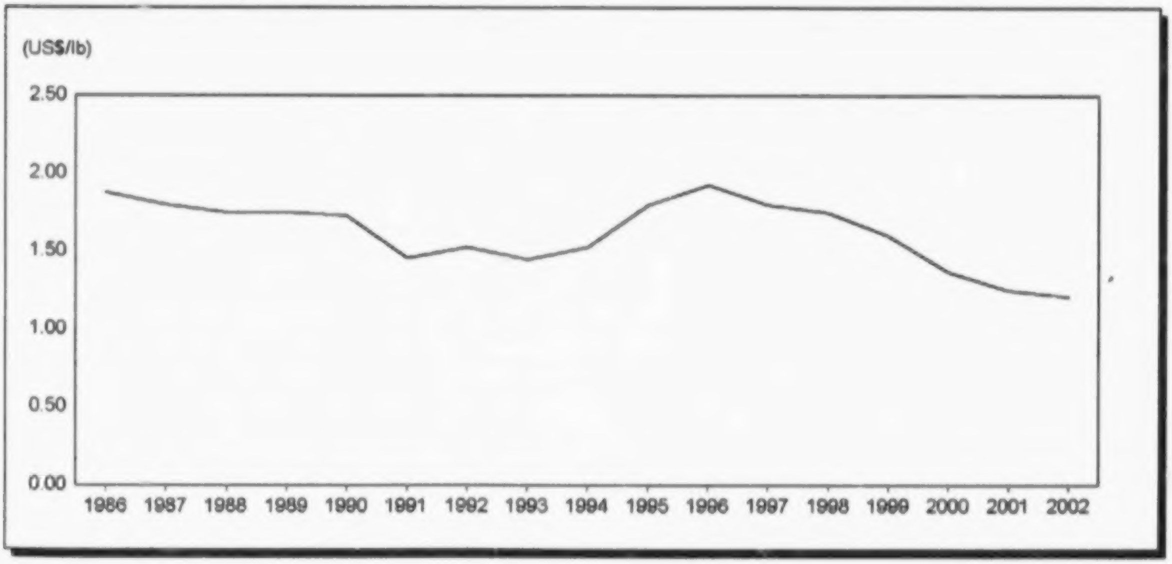
Canadian magnesium metal producers have web sites located at:

- Hydro Magnesium:
  www.magnesium. hydro.com
- Timminco Limited:
  www.timminco.com
- Noranda Magnesium Inc.:
  www.norandamagnesium.com

Canadian companies with an interest in producing magnesium metal[3] have web sites located at:

- Globex Mining Enterprises Inc.:
  www.globexmining.com
- Gossan Resources Ltd.:
  www.gossan.ca

Figure 4
Magnesium Prices, 1985-2002



Sources: Natural Resources Canada; *Metals Week* (U.S. Spot Western Mean).

- Hatch Associates of Canada:
  www.hatch.ca
- Lakefield Research of Canada Limited:
  www.lakefield.com
- Leader Mining International Inc.:
  www. leadermining.com
- Magnesium Alloy Corporation:
  www.magnesiumalloy.ca

Occurrence

Magnesium is the eighth most abundant element, comprising over 2% of the earth's crust. It is the third most abundant element dissolved in seawater with a concentration averaging 0.14% by weight. Magnesium does not naturally occur in its native or metallic state, but is found in more than 60 different minerals. The principal magnesium minerals include carbonate forms in dolomite and magnesite; as silicate forms in olivine and brucite; as an oxide/silicate in serpentine; and as a chloride in seawater, natural brines and evaporites. In the past, magnesium metal has been produced from dolomite, magnesite, brucite, seawater, brines, and residues from asbestos mines. Companies have also studied the production of magnesium from other magnesium-rich sources such as fly ash.

Technology

Magnesium metal is currently produced by several methods that can be classed into two general processes. These are: metallothermic, in which a reducing agent such as ferrosilicon or aluminum is mixed with magnesium oxide and heated in a furnace, generally in a vacuum to produce magnesium metal vapour; and electrolytic, in which molten magnesium chloride salts are electrolyzed/reduced to produce liquid magnesium metal. Larger plants generally use electrolytic methods, which account for about one half of the world's production. Metallothermic methods require more labour and are more suitable for small batch operations; these have become more important with the increased production from China.

Research has taken place to refine, modernize and replace existing production processes. Although production improvements have been made in existing operations, other options exist. Results of work to date have not been successfully adapted to large-scale production, although some changes in material supply, feedstock production and preparation have been implemented by existing producers.

Magnesium Production in Canada

In 1939, Dr. Lloyd Pidgeon and a research team in the National Research Council of Canada's (NRC) Division of Chemistry developed a method of producing pure solid metallic magnesium in a process that combined ferrosilicon and dolomite. The first magnesium produced by this method to be used in aircraft came from the NRC's Sussex Drive laboratories in Ottawa, Ontario. A pilot plant built with funding from mining companies became Dominion Magnesium Company after the war.

Canada is now the second largest producer of magnesium in the world. As of early 2003, there were three operating magnesium smelters in Canada.[4]

Timminco Limited was established in 1934 and produces high-purity metal (up to 99.98% pure) for specialized market applications at its 6000-t/y magnesium plant at Haley Station, Ontario. Timminco uses the Pidgeon magnesium process in which calcined dolomite is reduced by ferrosilicon in a vacuum retort in controlled batches of known and consistent chemistry. As a result, the company produces the highest-purity commercial magnesium in the world. Timminco mines the dolomite at the plant site, but purchases the ferrosilicon feed on the open market. The company also produces highly corrosion-resistant magnesium die-casting alloys and extruded anode rods for hot-water heaters. Timminco's magnesium products are used for a variety of applications such as alloying agents for aluminum and calcium, in Grignard reagents for the pharmaceutical industry, and in electronic products. (For further information, see Timminco's web site at www.timminco.com.)

Norsk Hydro Canada Inc., a wholly owned subsidiary of Norsk Hydro ASA of Norway, produces magnesium metal at a 48 000-t/y Bécancour, Quebec, plant using an electrolytic process and purchased magnesite. The plant opened in 1989 with a capacity of 40 000 t/y and has subsequently increased production through debottlenecking of the original plant. It also recycles magnesium scrap produced by its customers and has a remelt capacity of 20 000 t/y. This plant is one of the most efficient in the world and is the lowest-cost Western producer of magnesium metal. The company offers a global service network, including metal management and logistics, recycling, technical support and application development. (For further information, see Norsk Hydro's web site at www.magnesium.hydro.com.)

In early 2001, Magnola Metallurgy Inc. (owned 80% by Noranda Inc. and 20% by Société générale de financement du Québec) completed construction of its 58 000-t/y magnesium metal plant in Danville, Quebec. Magnola was to use asbestos mine tailings as a feedstock to a proprietary process developed by the Noranda Technology Center of Noranda Inc. to produce the magnesium chloride needed for electrolysis. The plant started producing magnesium metal in October 2000 in a plant based on electrolysis of magnesium chloride from the serpintine feedstock. Although the company faced some start-up problems, it expected to reach commercial production levels in 2002 but, in early 2003, closed the plant. The shut-down is for an indefinite period of time until the market conditions allow for a viable operation of the plant. (For further information see the company's web sites at www.norandamagnesium.com and www.noranda.com.)

Use

Although magnesium is consumed in some applications (such as in flares or pyrotechnics, or when magnesium is used in chemical reactions in the production of other metals), most use in industrial and consumer products is generally non-destructive and the metal can be recycled and re-used. The energy inherent in the metal remains and the process of recycling the metal recovers that energy in a repeating and sustainable manner. Discussions on metals taking place in a number of fora indicate that usage of the word "consumption" in reports should be modified to more appropriately reflect the actual use of the metal.

Magnesium metal is best known for its light weight and high strength-to-weight ratio, making it suitable for a wide range of applications. It is the lightest of all structural elements and is easily malleable and easily alloyed. Magnesium alloys are stiff and resist denting. When used as a structural material, magnesium is alloyed with other elements including aluminum, manganese, rare earth metals, silver, thorium, zinc and zirconium. When alloyed with one or more of these elements, the resulting alloys can have unusually high strength-to-weight ratios. Magnesium-aluminum alloys are the most common and are principally used in die-casting applications.

The use of magnesium in larger-scale structural applications is relatively new and metal and alloy development for specific applications is not as advanced as for better known metals such as iron or aluminum. In addition, ways to avoid potential problems with corrosion are not as well developed for magnesium. As a result, some magnesium alloys have limitations on their use due to this potential for corrosion in some environments. In addition, the use of some magnesium metal and magnesium alloys at higher temperature is limited due to the creep that can occur in those environments. Work by metal producers such as Noranda/Magnola and Hydro Magnesium has resulted in new creep-resistant alloys for use in higher-temperature environments. Engineering data on their physical properties are being generated to allow increased use in larger-component automotive applications such as transmission housings, oil pans and engine blocks.

The use of die-cast magnesium parts can help automobile manufacturers reduce total vehicle weight while meeting the consumer demand for larger vehicles. The interest in magnesium metal in the automotive market is largely due to weight savings of more than 30% compared to aluminum and a desire to increase fuel efficiency through weight reduction.

Magnesium has good vibration-dampening characteristics. Its lower heat of solidification, which increases die-casting production capacity by 25%, results in major process energy savings. Its characteristics also allow the casting of thinner and more complex shapes, which can replace a number of parts made with other materials, which in turn can also reduce the cost of assembly. Dies for magnesium castings are reported to have more than twice the life of aluminum dies and, at a magnesium-to-aluminum price ratio of about 1.7:1.0 or less, many magnesium metal parts can be fabricated at a lower cost than those made from aluminum. In this regard, over the last few years, the increased price of aluminum and the decreased price of magnesium have made the use of magnesium relatively more economical.

The primary use of magnesium metal is its use as an alloying agent for aluminum where it imparts strength and rigidity to alloys used in various applications including aluminum sheet, such as that used in the manufacture of aluminum beverage containers. These alloys allow the use of less material producing thinner walls and lighter containers than would normally otherwise be possible.

The next most important use for magnesium metal is for die-cast products. These castings can be used in structural applications, such as instrument panel beams of automobiles, or as equipment cases for electronic equipment such as cameras, cell phones, computers, portable tools and sporting goods. Magnesium's advantages for these applications are its good strength-to-weight ratio, heat dissipation, electromagnetic field containment, and radio frequency interference dissipation.

The third largest use of magnesium is as a deoxidizing and desulphurizing agent in the ferrous industry where it is consumed in the production of steel and cast iron. Magnesium is introduced into the melt during the production of nodular iron, which is used primarily for the production of ductile iron pipes and die-cast parts for use in automobiles and farm equipment.

Other uses are much smaller in comparison to those above. These include:

- Chemical uses: the manufacture of pharmaceutical and chemical products, perfumes and pyrotechnics;
- Electrochemical applications: use in the manufacture of batteries and in anodes for the cathodic protection of gas pipelines and water heaters;
- Wrought products: extruded products, sheets and plates; and
- Magnesium metal is also used to produce other metals such as titanium beryllium, zirconium, hafnium and uranium.

The biggest potential for growth in the use of magnesium lies in the aluminum alloy and automotive markets sectors. However, growth will be dependent on prices and price stability as magnesium continues to face stiff competition from other materials, including aluminum, steel and plastics.

Recycling

The production of recycled magnesium from metallic scrap requires about 5% of the energy required to produce primary magnesium. The recycling of old or post-consumer magnesium scrap is expected to increase with the anticipated growth in the use of magnesium die-cast automobile parts and electronics. In addition, casting operations produce a high proportion of new or process scrap in their operations that is recycled either on the site or at another location. Producers collect new magnesium scrap from their clients and recondition and recast the metal into a usable form and shape. This source of scrap is expected to increase with time as magnesium metal further penetrates the automotive and electronics markets and the vehicles and electrical equipment are scrapped. However, as technology and methods for recycling magnesium improve, it is likely that more recycling of this and other clean new scrap will take place in facilities using the original metal. As figures are not collected on this runaround or new scrap, statistics on recycling magnesium may eventually show a decrease, although recycling itself would not decrease.

Major North American auto manufacturers, including Daimler-Chrysler Canada Inc., Ford Motor Company and General Motors Corporation, use magnesium alloy parts containing recycled magnesium. The recovery and use of this recycled magnesium reduce the cost of die-cast components and contribute to sustainable practices in metal use.

Prices

Magnesium metal does not trade on the London Metal Exchange or the New York Mercantile Exchange. Producers and metal traders deal directly with users as the volumes of metal are not large enough for inclusion in an organized market. Producer and dealer pure and alloy magnesium metal price quotes can be found in various metal publications such as *Metal Bulletin*, *American Metal Market*, or other similar papers and journals with metals news.

ENDNOTES

[1] Canadian magnesium production data are confidential due to the limited number of companies reporting. This number is based on published capacity for primary metal. Note that other published estimates of Canadian magnesium production include quantities of recycled material.

[2] The company has subsequently sold the Cassiar property but retains an interest. It has also changed its name to Troutline Investments Inc. See the company's filings at www.sedar.com.

[3] If you are a Canadian company with an interest in producing magnesium metal and are not listed here and wish to be included, please contact the author by e-mail at wwagner @ nrcan.gc.ca.

[4] Noranada Magnesium has announced an interim closure of the Magnola smelter scheduled for April 2003. After that time, there will be two operating magnesium smelters in Canada.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of March 30, 2003. (3) Some differences are noted in some data from independent sources. Readers are cautioned to confirm this data. (4) Lorraine Ralph and others in the Minerals and Metals Statistics Division created Table 1 and provided input into other tables and figures. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

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TARIFFS[1]

Item No.	Description	Canada			United States (2)	EU (2)	Japan
		MFN	GPT	USA	Canada	MFN	MFN
3824.90.90.42	Granular metallic magnesium coated with inorganic salts, mixed with lime	7.5%	3%	Free	Free	6.5%	2.6%
3824.90.90.43	Other granular metallic magnesium coated with inorganic salts	7.5%	3%	Free	Free	6.5%	2.6%
8104.11	Magnesium and articles thereof, unwrought; containing by weight at least 99.8% of magnesium	2.5%	Free	Free	Free	5.3%	Free-3%
8104.19	Magnesium unwrought, other						
8104.19.10	Magnesium-rare earth, magnesium-didymium, magnesium-thorium, magnesium-zirconium and magnesium-thorium-neodymium-rare earth for use in the manufacture of magnesium castings	Free	Free	Free	Free	4%	Free-3%
8104.19.90	Other	2.5%	Free	Free	Free	4%	Free-3%
8104.20	Magnesium waste and scrap	Free	Free	Free	Free	Free	Free
8104.30	Magnesium raspings, turnings and granules, graded according to size; powders	2.5%	Free	Free	Free	4%	3%
8104.90	Other magnesium	2.5%	Free	Free	Free	4%	3%

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002); *Worldtariff Guidebook on Custom Tariff Schedules of Import Duties for Japan* (36th Annual Edition: 2002).

(1) Does not include countervail or anti-dumping duties, which may be applied to material of certain origin. (2) Duty suspension may apply for certain goods.

TABLE 1. CANADA, MAGNESIUM EXPORTS AND IMPORTS BY COMMODITY AND COUNTRY, 2001 AND 2002

Item No		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium				
	United States	1 625	8 053	6 791	28 888
	Netherlands	2 547	6 143	8 166	20 449
	Germany	4 638	12 928	1 482	4 267
	United Kingdom	315	2 449	603	2 532
	France	309	819	876	2 462
	United Arab Emirates	–	–	885	2 445
	Other countries	4 412	12 590	1 811	4 873
	Total	13 846	42 982	20 614	65 916
8104.19	Magnesium unwrought, other				
	United States	13 858	64 149	25 789	110 491
	Netherlands	783	3 084	5 797	19 807
	Italy	305	1 643	3 427	12 057
	Japan	153	581	317	1 262
	Taiwan	61	221	248	840
	Other countries	389	1 556	415	1 675
	Total	15 549	71 234	35 993	146 132
8104.20	Magnesium waste and scrap				
	United States	8 585	27 083	10 245	24 670
	Australia	34	202	21	118
	Other countries	2	5	–	–
	Total	8 621	27 290	10 266	24 788
8104.30	Magnesium raspings, turnings or granules, graded according to size, and powders				
	United States	1 571	6 496	1 454	5 369
	Ireland	290	2 210	270	2 010
	Netherlands	41	286	45	305
	Germany	65	496	42	296
	Other countries	175	1 163	36	254
	Total	2 142	10 651	1 847	8 234

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
8104.90	Magnesium and articles thereof, other				
	United States	2 564	20 169	2 016	18 104
	Australia	520	3 357	453	3 118
	Netherlands	14	129	34	185
	Other countries	36	413	20	238
	Total	3 134	24 068	2 523	21 645
	Total exports	43 292	176 225	71 243	266 715
IMPORTS					
3824.90.90.42	Granular metallic magnesium coated with inorganic salts, mixed with lime				
	United States	607	2 376	33	34
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium				
	China	7 478	18 170	9 440	21 483
	United States	2 679	10 439	6 995	16 770
	Israel	687	2 315	280	910
	Russia	2 769	9 985	81	240
	Switzerland	4	19	2	19
	Brazil	340	1 140	–	–
	Other countries	426	1 432	–	–
	Total	14 383	43 500	16 798	39 422
8104.19	Magnesium unwrought, other				
	Russia	1 288	5 383	5 210	21 987
	United States	2 444	12 316	2 868	13 626
	United Kingdom	239	2 393	152	1 634
	China	143	965	381	1 619
	Israel	–	–	185	993
	Norway	1 934	7 368	144	422
	Other countries	44	182	–	–
	Total	6 092	28 607	8 940	40 281
8104.20	Magnesium waste and scrap				
	United States	7 530	26 945	6 607	22 000
	Mexico	38	149	91	318
	China	67	148	162	268
	Russia	2 563	9 839	47	167
	Other countries	322	1 000	4	13
	Total	10 520	38 081	6 911	22 766
8104.30	Magnesium raspings, turnings or granules, graded according to size and powders				
	United States	716	3 384	871	3 699
	China	5	22	81	199
	Other countries	34	126	20	87
	Total	755	3 532	972	3 985
8104.90	Magnesium and articles thereof, other				
	United States	929	7 793	1 182	7 344
	China	173	1 057	103	565
	Other countries	19	106	4	46
	Total	1 121	8 956	1 289	7 955
	Total imports	33 478	125 052	34 943	114 443

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, MAGNESIUM USE,[1] 1991-2001

	1991 (a)	1992 (a)	1993 (a)	1994	1995 (a)	1996	1997	1998 (a)	1999 (a)	2000 (a)	2001 (p)
						(tonnes)					
Castings and wrought products (2)	4 604	6 915	7 678	8 940	12 488	11 197	16 795	16 687	17 951	(r) 22 728	26 818
Aluminum alloys	9 215	9 203	10 174	12 389	12 323	14 022	14 793	13 417	13 741	13 466	12 551
Other uses (3)	1 926	2 005	2 162	2 234	2 329	2 357	2 438	2 685	2 727	3 960	5 556
Total	15 745	18 123	20 014	23 563	27 140	27 576	34 026	32 790	34 419	(r) 40 154	44 925

Source: Natural Resources Canada.

(p) Preliminary; (r) Revised.

(a) Increase in number of companies being surveyed.

(1) Available data as reported by users. (2) Die, permanent mould and sand castings, structural shapes, tubings, forgings, sheet and plate. (3) Cathodic protection, reducing agents, deoxidizers and other alloys.

Note: Numbers may not add to totals due to rounding.

TABLE 3. WORLD PRODUCTION OF MAGNESIUM, 1994-2002

Country	Rank in 2001	1994	1995	1996	1997	1998	1999	2000	2001	2002 (e)
						(000 tonnes)				
PRIMARY PRODUCTION										
China (2)	1	11.0	93.6	73.2	76.0	70.5	120.7	142.1	(r) 199.7	231.7
Canada (1,e)	2	28.9	48.1	54.0	57.7	77.1	73.7	85.7	83.4	80.0
Russia	3	35.4	37.5	31.5	33.0	34.1	35.2	35.5	35.0	35.0
United States	4	128.5	142.1	133.1	124.8	106.1	75.0	94.0	50.0	20.0
Israel	5	–	–	(r) 0.1	7.4	24.5	(r) 24.3	31.7	34.0	28.0
Kazakhstan	6	3.0	9.0	13.4	17.9	20.9	(r) 11.0	10.4	16.5	18.0
Norway	7	27.6	28.0	37.8	34.2	35.4	40.8	41.4	36.0	10.0
Brazil	8	8.8	9.7	9.0	9.0	9.0	(r) 8.0	5.7	5.5	4.5
India	9	1.0	1.0	1.0	1.0	1.5	(r) 1.0	(r) 0.5	0.5	0.5
France		12.3	14.5	14.0	13.8	14.7	(r) 16.2	(r) 16.5	4.8	
Former Yugoslavia		–	2.6	3.1	3.9	4.0	1.2	1.3	0.2	
Ukraine		12.0	13.0	12.9	7.7	5.0	–	–	–	
Japan		3.4	–	–	–	–	–	–	–	
Total primary		271.9	399.1	(r) 383.1	386.4	402.8	(r) 407.1	(r) 464.8	(r) 465.6	427.7
RECYCLED PRODUCTION (3)										
United States	1	62.1	65.1	71.2	77.6	77.1	(r) 86.1	82.3	65.8	73.7
United Kingdom	2	0.5	0.5	0.5	0.5	0.5	(r) 0.5	0.5	0.5	0.7
Japan		19.0	11.8	21.2	22.8	(r) –	(r) –	(r) –	(r) –	–
Brazil		1.6	1.6	1.6	1.6	(r) –	(r) –	(r) –	(r) –	–
Austria		0.1	0.1	–	–	–	–	–	–	
Total recycled		83.3	79.1	94.5	102.5	(r) 77.6	(r) 86.6	(r) 82.8	66.3	74.4
Total primary and recycled		355.2	478.2	(r) 477.6	488.9	502.0	(r) 530.5	564.7	531.9	502.1

Sources: International Consultative Group on Nonferrous Metals Statistics; China Magnesium Association as reported in various journals.

– Nil; (e) Estimated by author; (r) Revised.

(1) Estimate per U.S. Geological Survey, includes secondary. (2) Numbers used in table are from the International Consultative Group on Nonferrous Metal Statistics. As reported in various journals, Chinese Magnesium Association reported in various journals higher numbers for Chinese production: 1994 - 25 000 t; 1997 - 92 000 t; 1998 - 120 000 t; 1999 - 157 000 t; 2000 - 194 000 t; 2001 - 268 000 t. (3) Recycled magnesium facilities exist in other locations, including Canada, which have not reported separate production figures for recycled magnesium due to confidentiality and other reasons.

Mineral Aggregates

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Total Canadian shipments of regular-weight mineral aggregates in 2002 have been estimated to be 342 Mt, based on preliminary data, compared to 355 Mt in 2001, based on final data. Specifically, these data relate to the combined amounts of crushed stone, miscellaneous stone, and sand and gravel, essentially all for construction uses (Table 1, By Use, and Table 2, respectively). Relevant subtotals of shipments of crushed stone and miscellaneous stone by rock type, e.g., limestone, granite and other types of stone, are included in a separate commodity chapter entitled "Stone."

Ongoing investments related to the Strategic Infrastructure Foundation continued in 2002 with expectations that investments of about $1.5 billion per year will continue through 2003 to assist large infrastructure projects and to encourage public-private partnerships. This funding program is in addition to the Infrastructure Canada Program, which has been allocated $2.05 billion over six years (2000/01 to 2005/06). The latter is a cost-shared program expected to result in total construction-related spending of about $6 billion when combined with contributions from other partners.

Exports of construction aggregates, mainly to the United States, are growing in importance in Atlantic Canada and in British Columbia. In the United States, the level of funding planned under the U.S. *Transportation Equity Act for the 21st Century* remains uncertain; however, this is not expected to affect export markets for strategically located producers in Canada.

Port au Port quarries announced plans to establish a dolomite/limestone operation at Aguathuna on the Port au Port Peninsula. Shipments of aggregates for construction, as well as for chemical and other uses, are planned in 2003.

The demand for construction aggregates in 2003 is expected to be about the same as in 2002 because of continued strength in residential construction and in non-residential building. The average unit values of construction aggregates shipped, as reported by producers, generally continued to increase in pace with the rate of inflation with selling prices varying considerably depending on proximity to consumers.

Information on lightweight aggregates, including ferrous slags, can be found in Tables 6-11, inclusive.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

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TABLE 1. CANADA, STONE PRODUCTION, 2000-02

Item No.	2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY (1)						
Newfoundland and Labrador	4 505	27 859	4 390	31 522	4 625	35 788
Nova Scotia	8 379	51 246	8 749	59 028	8 246	55 570
New Brunswick	3 294	19 429	4 204	20 073	3 178	19 074
Quebec	31 550	229 984	36 436	266 536	35 363	256 549
Ontario	58 704	474 155	57 969	501 956	55 633	514 805
Manitoba	4 007	19 688	3 744	17 837	3 744	18 558
Saskatchewan	x	x	x	x	x	x
Alberta	x	x	478	5 599	335	4 445
British Columbia	6 636	49 172	7 212	51 412	7 171	60 179
Northwest Territories	186	2 952	1 577	3 085	818	6 854
Total	118 222	881 260	124 758	957 048	119 113	971 822
BY USE (2)						
Stone (Dimension)						
Dimension stone						
Rough	360	50 388	363	53 760	. .	. .
Monumental and ornamental stone (n.f.)	111	10 598	106	9 323	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	105	16 311	110	16 136	. .	. .
Total dimension stone	576	77 297	579	79 219	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	21 830	131 073	21 502	148 723	. .	. .
Asphalt aggregate	11 509	72 753	12 152	79 648	. .	. .
Road metal	36 478	192 907	37 792	203 984	. .	. .
Railroad ballast (includes traprock)	1 681	14 375	1 475	12 824	. .	. .
Other uses	36 061	201 603	41 693	236 138	. .	. .
Chemical and metallurgical						
Cement plants, Canada	14 776	44 570	15 548	50 300	. .	. .
Cement plants, foreign	539	2 273	454	2 051	. .	. .
Flux in iron and steel furnaces	680	6 279	477	3 275	. .	. .
Flux in nonferrous smelters	100	1 519	145	1 969	. .	. .
Glass factories	51	738	44	591	. .	. .
Lime plants, Canada	3 184	19 513	2 970	17 279	. .	. .
Lime plants, foreign	1 437	8 586	1 825	13 328	. .	. .
Pulp and paper mills	118	1 271	69	642	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	1 763	12 777	1 767	10 657	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	2	68	2	60	. .	. .
Roofing granules	873	37 348	854	40 426	. .	. .
Poultry grit	173	1 427	232	2 520	. .	. .
Stucco dash	23	3 985	20	4 452	. .	. .
Terrazzo chips	9	666	6	586	. .	. .
Rock wool	25	431	30	430	. .	. .
Rubble and riprap	1 257	4 476	867	3 650	. .	. .
Other uses	1 562	8 245	1 591	10 313	. .	. .
Pulverized stone						
Whiting	44	3 971	37	3 258	. .	. .
Asphalt filler	200	363	126	125	. .	. .
Dusting coal mines	1	51	1	89	. .	. .
Agricultural purposes and fertilizer plants	1 113	18 500	847	13 170	. .	. .
Other uses	1 064	82 428	1 259	88 782	. .	. .
Total crushed stone	136 554	872 196	143 783	949 271	. .	. .
Total all stone	137 130	949 493	144 362	1 028 490	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; n.f. Not finished or dressed; (p) Preliminary; x Confidential.
(1) Data exclude stone used in the Canadian cement, lime and clay industries. (2) Data include stone used in the Canadian cement, lime and clay industries.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, PRODUCTION OF SAND AND GRAVEL,[1] BY PROVINCE AND TERRITORY, 2000-02

	2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
Newfoundland and Labrador	2 911	12 371	2 594	10 249	2 400	9 526
Prince Edward Island	258	1 260	167	781	164	764
Nova Scotia	2 547	11 591	2 959	14 096	3 320	15 980
New Brunswick	3 356	10 716	2 529	9 748	2 540	9 582
Quebec	31 569	84 438	29 487	85 553	26 274	76 357
Ontario	99 848	395 832	97 878	433 403	98 979	438 239
Manitoba	9 571	26 968	10 952	32 982	10 844	33 299
Saskatchewan	11 064	39 151	13 195	48 106	11 532	45 724
Alberta	42 372	208 591	44 214	255 313	40 599	235 504
British Columbia	33 872	174 742	30 687	165 213	31 092	175 870
Yukon	1 087	2 966	1 226	3 646	1 213	3 635
Northwest Territories	446	2 535	598	3 143	578	2 908
Total	238 901	971 159	236 486	1 062 234	229 535	1 047 388

Source: Natural Resources Canada.

(p) Preliminary.

(1) Production represents shipments of natural gravel, sand and crushed gravel. Does not include shipments to Canadian cement plants.

Note: Numbers may not add to totals due to rounding.

TABLE 3. AVAILABLE DATA ON USE OF SAND AND GRAVEL, BY REGION, 2000 AND 2001

	Year	Atlantic Provinces	Quebec	Ontario	Western Provinces (1)	Canada
				(000 tonnes)		
Road bed, surface	2000	3 335	20 584	35 969	48 867	108 754
	2001	3 326	18 892	30 076	47 157	99 451
Roads, ice control	2000	496	681	1 999	2 494	5 670
	2001	497	706	1 802	2 579	5 583
Concrete aggregate	2000	1 583	3 648	13 969	18 586	37 786
	2001	1 776	3 300	17 107	20 172	42 355
Asphalt aggregate	2000	877	2 460	8 070	11 026	22 433
	2001	756	2 551	10 099	11 258	24 663
Railroad ballast	2000	–	4	2	132	138
	2001	6	193	1	148	348
Mortar sand	2000	46	315	1 032	253	1 645
	2001	60	400	1 253	148	1 861
Backfill for mines	2000	364	139	1 210	181	1 893
	2001	450	136	1 318	125	2 029
Fill	2000	1 117	2 255	9 352	5 231	17 954
	2001	752	1 984	7 126	5 469	15 332
Other purposes	2000	1 326	1 485	28 391	11 685	42 886
	2001	803	1 325	29 362	13 853	45 342
Total	2000	9 143	31 569	99 993	98 455	239 160
	2001	8 425	29 487	98 143	100 909	236 964

Source: Natural Resources Canada.

– Nil.

(1) The western provinces include the Yukon and Northwest Territories.

Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, EXPORTS AND IMPORTS OF SAND AND GRAVEL AND CRUSHED STONE, 2000-02

Item No.		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2505.90	Natural sands n.e.s., excluding metal-bearing sands						
	United States	456 377	4 736	512 754	4 266	1 017 546	9 156
	Bahamas	61 811	1 258	–	–	67 829	1 923
	Bermuda	–	–	–	–	11 571	232
	Chile	–	–	231	82	39	14
	St. Pierre and Miquelon	–	–	–	–	36	7
	France	–	–	–	–	10	4
	Germany	–	–	–	–	1	. . .
	Argentina	313	67	–	–	–	–
	Philippines	201	30	–	–	–	–
	Trinidad and Tobago	202	33	99	17	–	–
	Venezuela	455	99	–	–	–	–
	Cayman Islands	–	–	37 307	789	–	–
	Mexico	–	–	2	. . .	–	–
	Total	519 359	6 223	550 393	5 154	1 097 032	11 336
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.						
	United States	3 130 583	31 944	4 884 125	48 362	5 078 843	62 467
	Barbados	–	–	27 644	757	10 126	139
	Japan	6	47	–	–	4 249	111
	Hong Kong	–	–	–	–	6 320	49
	Saudi Arabia	–	–	–	–	28	–
	Spain	–	–	–	–	1	–
	Vietnam	–	–	–	–	227	–
	Bahamas	47 239	1 079	–	–	–	–
	Bermuda	18 965	191	–	–	–	–
	Jamaica	44 631	931	–	–	–	–
	Panama	536 580	1 258	–	–	–	–
	France	–	–	5	11	–	–
	Venezuela	–	–	13	. . .	–	–
	Total	3 778 004	35 450	4 911 787	49 130	5 099 794	62 766
2517.41	Marble granules, chippings and powder of 25.15 or 25.16, heat-treated or not						
	United States	347 873	56 015	49 078	8 983	32 365	6 864
2517.49	Granules, chippings and powder, n.e.s., of 25.15 or 25.16, heat-treated or not						
	United States	100 810	6 089	9 347	612	4 692	434
	Other countries	43	14	26 173	657	30	12
	Total	100 853	6 103	35 520	1 269	4 722	446
2518.10	Dolomite, not calcined						
	United States	2 800 364	28 836	2 872 450	30 076	3 095 736	34 002
	Venezuela	423 821	4 436	318 247	3 414	297 485	2 997
	Mexico	311 456	2 771	142 974	1 336	134 722	1 258
	Trinidad and Tobago	109 469	1 976	38 738	740	84 517	995
	Brazil	26 445	161	–	–	–	–
	Romania	73	14	91	18	–	–
	Total	3 671 628	38 194	3 372 500	35 584	3 612 460	39 252
2518.20	Calcined dolomite						
	United States	15 749	4 112	11 134	4 648	9 785	1 214

TABLE 4 (cont'd)

Item No.		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
2521.00	Limestone flux; limestone and other calcareous stone used for lime or cement						
	United States	2 856 799	18 632	2 360 689	15 517	2 713 242	18 191
	Mexico	35 322	293	61 543	531	91 616	989
	China	–	–	–	–	10 671	430
	Sweden	–	–	–	–	509	2
	Cuba	–	–	237	. . .	–	–
	India	–	–	4 694	24	–	–
	Total	2 892 121	18 925	2 427 163	16 072	2 816 038	19 612
IMPORTS							
2505.90	Natural sands n.e.s., excluding metal-bearing sands						
	United States	322 305	9 110	131 671	7 286	65 644	6 883
	China	492	128	1 274	308	1 134	392
	South Africa	171	30	15 820	1 836	2 308	338
	Australia	59	13	1 349	80	434	113
	United Kingdom	168	41	144	25	146	30
	Philippines	239	51	216	44	55	23
	Other countries	2 656	108	351	60	170	25
	Total	326 090	9 481	150 825	9 639	69 891	7 804
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.						
	United States	3 085 293	16 859	3 106 549	16 493	3 310 507	19 278
	Israel	18 364	74	50 045	216	48 830	338
	China	8 976	137	16 939	227	6 478	128
	India	36	1	143	18	284	62
	Philippines	2 527	48	1 237	13	3 271	32
	Brazil	280	3	261	26	192	27
	France	1 979	20	5 683	35	1 717	17
	Other countries	9 823	172	38 820	276	1 708	29
	Total	3 127 278	17 314	3 219 677	17 304	3 372 987	19 911
2517.20	Macadam of slag, dross or similar industrial waste, etc.						
	United States	30 179	229	7 628	56	2 613	17
	Other countries	1 464	11	99	1	614	2
	Total	31 643	240	7 727	57	3 227	19
2517.30	Tarred macadam						
	United States	158	7	539	22	259	12
2517.41	Marble granules, chippings and powder of 25.15 or 25.16, heat-treated or not						
	United States	58 918	10 395	73 320	15 546	82 749	16 944
	Italy	187	22	75	12	104	16
	Other countries	96	18	22	4	16	2
	Total	59 201	10 435	73 417	15 562	82 869	16 962
2517.49	Granules, chippings and powder, n.e.s., of 25.15 or 25.16, heat-treated or not						
	United States	28 480	1 614	25 437	1 519	25 635	2 196
	France	210	25	1 027	80	315	36
	Spain	–	–	–	–	223	29
	Brazil	545	35	420	29	328	29
	Other countries	823	56	975	63	841	50
	Total	30 058	1 730	27 859	1 691	27 342	2 340

TABLE 4 (cont'd)

Item No.		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
2518.10	Dolomite, not calcinated						
	United States	4 784	866	3 579	698	2 566	534
	United Kingdom	27	3	–	–	32	9
	Italy	–	–	–	–	24	8
	Canada	52	19	–	–	36	4
	Other countries	3	. . .	17	3	11	3
	Total	4 866	888	3 596	701	2 669	558
2518.20	Calcined dolomite						
	United States	3 810	761	19 436	2 683	46 590	6 936
	Italy	–	–	–	–	25	18
	Canada	320	35	–	–	–	–
	Total	4 130	796	19 436	2 683	46 615	6 954
2518.30	Agglomerated dolomite (including tarred dolomite)						
	United States	556	161	556	187	857	307
	Austria	102	37	70	25	149	54
	Other countries	1	. . .	–	–	25	11
	Total	659	218	626	212	1 031	372
2521.00	Limestone flux; limestone and other calcareous stone used for lime or cement						
	United States	4 026 594	17 806	4 163 352	19 771	1 291 078	20 817
	Italy	24 564	155	6 300	19	339	28
	Total	4 133 904	18 125	4 180 230	19 835	1 298 610	20 909

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 5. LIGHTWEIGHT AGGREGATE PRODUCERS IN CANADA, 2001

Company	Location	Commodity	Remarks
ATLANTIC PROVINCES			
Fafard Peat Moss Company Ltd.	Inkerman, N.B.	Perlite, vermiculite	Processed for use in horticulture.
Le Groupe Berger Ltée	Escuminac, N.B.	Vermiculite	Processed for use in horticulture.
Sun Gro Horticulture Canada Ltd.	Maisonnette, N.B.	Perlite	Processed for use in horticulture.
QUEBEC			
Le Groupe Berger Ltée	Saint-Modeste	Perlite, vermiculite	Processed for use in horticulture.
Normiska Corp.	Lachine (plant)	Vermiculite, perlite	Vermiculite processed for use in loose insulation, horticulture and concrete products. Perlite processed for use in horticulture.
Premier Horticulture	Rivière-du-Loup	Perlite, vermiculite	Processed for use in horticulture.
Perlite Canada Inc.	Baie-du-Febvre	Perlite, vermiculite	Processed for use in horticulture.
ONTARIO			
Grace Canada, Inc.	Ajax	Vermiculite, perlite	Vermiculite processed for use in horticulture, as loose insulation, and in friction materials. Perlite processed for use in gypsum plaster, horticulture, refractories and as loose insulation.
Lafarge Canada Inc., Hamilton Slag Division	Hamilton	Slag	Used in concrete products industry.
PRAIRIE PROVINCES			
Cindercrete Products Ltd.	Saskatoon, Sask.	Expanded clay	Processed for concrete products industry.
Grace Canada, Inc.	Winnipeg, Man.	Vermiculite, perlite	Perlite processed for use in gypsum plaster, loose insulation and in horticulture.
	Edmonton, Alta.	Vermiculite, perlite	Vermiculite processed for use in horticulture and in fricton material and loose insulation.
Inland Cement Limited	Calgary, Alta.	Expanded shale	Plant closed in 2002.
	Edmonton, Alta.	Expanded clay	Processed for concrete products industry, and for loose insulation.
Sun Gro Horticulture Canada Ltd.	Elma, Man.	Perlite	Processed for use in horticulture.
	Seba Beach, Alta.	Perlite	Processed for use in horticulture.
BRITISH COLUMBIA			
Canada Pumice Corporation	Quesnel	Pumice, shale	A range of pumice and shale products for construction and landscaping material.
Great Pacific Pumice Inc.	Mt. Meager	Pumice	Used in horticulture, concrete products industry and as loose insulation.
Ocean Concrete Products Limited	Vancouver	Pumice	Purchased for concrete products industry.

Source: Natural Resources Canada, reported from NRCan 2001 annual survey questionnaire "Production of Lightweight Aggregates in Canada."

TABLE 6. CANADA, IMPORTS AND EXPORTS OF VERMICULITE, PERLITE AND PUMICE, 2000-02

Item No.		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2513.11	Pumice stone, crude or in irregular pieces, including crushed pumice						
	United States	–	–	–	–	27	10
	Colombia	–	–	–	–	1	1
	Total	–	–	–	–	28	11
2513.19	Pumice stone, other						
	United States	–	–	. . .	5	–	–
2530.10	Vermiculite, perlite and chlorites, unexpanded						
	United States	34	17	–	–	47	49
	South Korea	–	–	–	–	28	20
	Chile	14	8	24	13	4	3
	Saint Vincent and the Grenadines	–	–	–	–	1	. . .
	Trinidad and Tobago	1	. . .	–	–	0	–
	Dominican Republic	–	–	5	10	–	–
	Total	49	25	29	23	80	72
6806.20	Exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials (including intermixtures thereof)						
	United States	2 308	1 577	2 248	1 699	1 682	1 361
	Czech Republic	–	–	1	3	–	–
	Total	2 308	1 577	2 249	1 702	1 682	1 361
IMPORTS							
2513.11	Pumice stone, crude or in irregular pieces, including crushed pumice						
	United States	4 985	804	5 841	742	5 277	695
	Turkey	5 298	684	3 423	344	3 881	393
	Other countries	149	26	81	18	24	8
	Total	10 432	1 514	9 345	1 104	9 182	1 096
2513.19	Pumice stone, other						
	United States	3 817	677	3 302	643	5 236	921
	Taiwan	89	22	37	11	378	106
	South Korea	170	46	545	71	246	55
	Russia	140	46	–	–	167	43
	Other countries	417	90	574	126	1 424	169
	Total	4 633	881	4 458	851	7 451	1 294
2530.10.00.10	Vermiculite, unexpanded						
	South Africa	11 115	2 663	22 090	5 631	15 713	4 266
	United States	16 583	(r) 2 929	14 742	2 967	14 593	3 037
	Zimbabwe	–	–	–	–	4 630	947
	Other countries	1 247	223	1 214	192	365	84
	Total	28 945	(r) 5 815	38 046	8 790	35 301	8 334
2530.10.00.20	Perlite, unexpanded						
	United States	27 854	4 961	29 754	5 876	28 343	5 234
	Greece	20 974	2 554	37 589	3 859	44 495	4 002
	Other countries	24	10	–	–	1	. . .
	Total	48 852	7 525	67 343	9 735	72 839	9 236

TABLE 6 (cont'd)

Item No.		2000		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
3802.90.00.20	Activated perlite, excluding expanded perlite ground to be employed in filtering						
	United States	503	288	638	365	268	145
	Total	503	288	638	365	268	145
6806.20.00.10	Exfoliated (expanded) vermiculite						
	United States	439	(r) 1 608	388	1 391	696	2 162
	Other countries	1	4	17	42	10	37
	Total	440	(r) 1 612	405	1 433	706	2 199
6806.20.00.20	Expanded perlite						
	United States	9 636	6 766	10 076	7 427	10 227	7 800
	Other countries	9	4	25	41	54	51
	Total	9 645	6 770	10 101	7 468	10 281	7 851

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 7. CANADA, LIGHTWEIGHT AGGREGATES PRODUCED, SOLD AND USED, 2000 AND 2001

	2000				2001 (p)			
	Produced		Sold and Used		Produced		Sold and Used	
	(m^3)	($)	(m^3)	($)	(m^3)	($)	(m^3)	($)
FROM DOMESTIC AND/OR IMPORTED RAW MATERIALS								
Expanded clay, shale and slag (1)	392 029	11 018 236	389 398	10 873 433	352 079	9 869 742	374 407	11 176 563
FROM IMPORTED CRUDE MATERIALS								
Expanded perlite and exfoliated vermiculite (1)	675 602	38 778 030	708 095	41 036 475	714 635	52 088 769	750 585	54 811 035
Total	1 067 631	49 796 266	1 097 493	51 909 908	1 066 714	61 958 511	1 124 992	65 987 598

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada" (see Table 5 for list of establishments surveyed).
(p) Preliminary.
(1) Combined to avoid disclosing confidential company data.

TABLE 8. CANADA, SALES OF EXPANDED SLAG, PERCENTAGE BY END USE, 1999-2001

Use	1999	2000	2001
		(%)	
Concrete block manufacture	90.0	90.0	80.0
Ready-mix concrete	10.0	10.0	10.0
Miscellaneous uses	–	–	10.0

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 9. CANADA, SALES OF EXPANDED CLAY AND SHALE, PERCENTAGE BY END USE, 1999-2001

Use	1999	2000	2001
		(%)	
Concrete block manufacture	52.7	50.1	54.1
Loose insulation	43.4	43.2	42.7
Precast concrete manufacture	2.0	2.0	1.7
Ready-mix concrete	2.0	0.7	1.2
Horticulture and miscellaneous uses	–	4.0	0.3

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 10. CANADA, SALES OF EXPANDED PERLITE, PERCENTAGE BY END USE, 1999-2001

Use	1999	2000	2001
		(%)	
Horticulture and agriculture	93.9	94.0	94.4
Loose insulation and miscellaneous uses	5.7	5.5	4.9
Insulation			
in gypsum products	0.4	0.5	0.7
in other construction materials	–	–	2.3

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 11. CANADA, SALES OF EXPANDED VERMICULITE, PERCENTAGE BY END USE, 1999-2001

Use	1999	2000	2001 (p)
		(%)	
Horticulture	78.9	84.8	83.4
Loose insulation	2.6	3.0	4.3
Miscellaneous uses	18.5	12.2	12.2

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
(p) Preliminary.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

Nickel

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(Author notes: [1] For more detailed information about Canadian facilities, refer to the Nickel chapter of the "2000 Canadian Minerals Yearbook." [2] Only material related to events in 2002 is covered in this review. [3] This chapter includes some information about cobalt as it relates to nickel; it does not provide a comprehensive review of cobalt.)

Abbreviations used in this review include:

Au Gold; Co Cobalt; Cu Copper; Fe Iron; FeNi Ferronickel; PAL Pressure acid leach; Pd Palladium; Pt Platinum; Ni Nickel; PGMs Platinum group metals.

OVERVIEW

World nickel mine production increased by 5000 t from 2001 to reach 1.229 Mt in 2002, an increase of 0.4%. World production of refined and finished nickel rose by 18 900 t to reach 1.179 Mt in 2002, an increase of 1.6%. Nickel use (formerly called "consumption") reversed its decline to increase by 67 000 t to 1.117 Mt in 2002, up 6.1%. Prices started out at the year's low of US$5625/t on January 3, peaked in mid-June at US$7725/t, slipped back to a trough of US$6234/t in September, moved up to US$7565/t in early December, and then finished the year at US$7100/t. The average price for the year was US$6772/t, or US$3.07/lb, compared to US$5948/t in 2001.

Cobalt data are less well documented than nickel data. A principal source of world information is The Cobalt Development Institute (CDI) (www.thecdi.com). Data from the CDI are shown in Table 13, which shows cobalt production plus deliveries from stockpiles for the period 1997-2002.

A list of Canadian nickel producers, their web sites, and the locations from which Canadian securities filing information can be obtained are provided in Table 3.

Canadian mine production of nickel (nickel contained in concentrates produced) was 188 071 t in 2002 (a revised 194 058 t[1] in 2001).[2] Canadian primary nickel production of Class I and Class II nickel, as defined by the International Nickel Study Group (INSG), was 144 476 t (140 591 t) in 2001. The locations of Canadian nickel production facilities are shown in Figure 1.

WORLD NICKEL DATA

	2001	2002
	(000 t)	
Mine production	1 224	1 229
Finished production (1)	1 148	1 179
Usage (consumption)	1 104	1 171

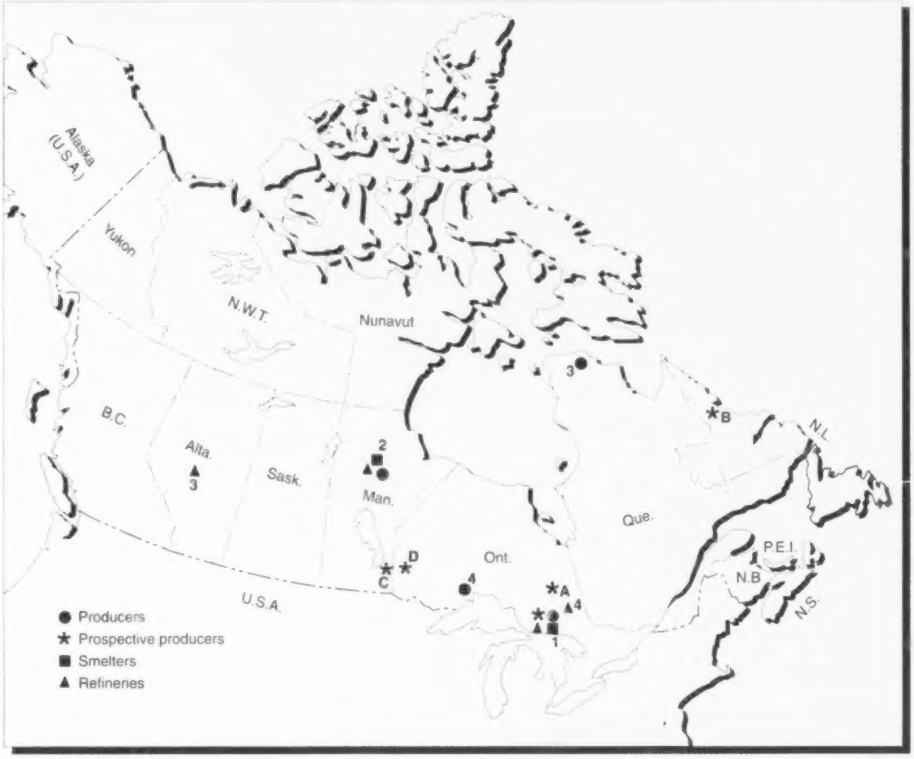
Source: International Nickel Study Group (INSG), *World Nickel Statistics - October 2003* (data rounded to nearest 1000 t).
(1) Includes production of nickel in chemicals.
Note: See Tables 8, 9 and 10 in this article for data from 1998 to 2002.

LME ASK PRICES, 2002

	Cash	3	15	27
		Month		
		(US$/t)		
Average	6 772	6 750	6 677	6 588
Maximum	7 725	7 735	7 480	7 355
Minimum	5 625	5 510	5 575	5 550

Sources: INSG; London Metal Exchange (LME).
Notes: Cash ask price = settlement price. Refer to Figure 4 for a graph of nickel prices in 2002 and for the period 1986-2002.

Figure 1
Nickel and Cobalt in Canada, 2002


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
N.L.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
4
A
B
C
D
● Producers
★ Prospective producers
■ Smelters
▲ Refineries

Numbers and letters refer to locations on map above

PRODUCERS

1. Falconbridge Limited (Fraser, Lindsley, Onaping-Craig, Lockerby)
1. Inco Limited (Copper Cliff North, Copper Cliff South, Creighton, Garson, Gertrude, McCreedy/Coleman, Stobie)
2. Inco Limited (Thompson, Birchtree)
3. Falconbridge Limited (Raglan)
4. North American Palladium Ltd. (Lac des Iles)

SMELTERS

1. Falconbridge Limited (Falconbridge)
1. Inco Limited (Copper Cliff)
2. Inco Limited (Thompson)

REFINERIES

1. Inco Limited (Sudbury)
2. Inco Limited (Thompson)
3. Sherritt International Corporation (Fort Saskatchewan)
4. Canmine Resources Corporation (Cobalt, Ontario)

PROSPECTIVE PRODUCERS

A. Outokumpu Mines Ltd. (Moncalm Township) (mine)
B. Inco Limited (Voisey's Bay mine)
C. Canmine Resources Corporation (Maskwa) (mine)
D. Canmine Resources Corporation (Werner Lake) (mine)

CANADIAN DATA

	2001	2002
	(t)	
Ni mine production (1)	(r) 194 058	187 791
Ni in concentrates shipped (2)	(r) 184 300	178 338
Ni refined production (3)	(r) 140 591	144 476
Ni usage (4)	17 735	18 955
Co mineral production (2)	2 112	2 027
Co metal production (3)	4 063	4 303
Co usage (4)	94	92

Sources: Nickel data: Table 7 of Production of Canada's Leading Minerals, ISSN 0709-292X, SS # 02-12; available at: http://mmds1.mms.nrcan.gc.ca/mmsd/data/2002/02mtly12.p

(r) Revised.

Ni = nickel; Co = cobalt.

(1) Metal in concentrates produced from Canadian mines.
(2) Recoverable metal in concentrates shipped from Canadian mines. (3) Metal produced, whether from domestic or foreign origin. (4) Use includes metal in scrap and other recycled forms.

Canada is a large net exporter of nickel. Figure 2 presents a snapshot of the major components of Canadian trade in 2002. The values are shown in U.S. currency for ease of international comparison; the trade tables 1a and 1c show detailed trade in Canadian currency. As can be seen from Figure 2, exports outpaced imports; Canadian nickel exports were 437% greater than nickel imports in 2002, providing a trade balance of US$1165 million or C$1823 million. The imports with the largest values are the residues and concentrates imported for further processing, which together amounted to 75% of total nickel imports by value. The most significant exports were unwrought nickel at 43% of nickel exports followed by nickel in matte and nickel in nickel oxide sinters at 24% and 22%, respectively. These three categories accounted for 89% of total Canadian nickel exports.

Canadian exports and imports of various forms of nickel are shown in Table 1a; some data refer to contained nickel and other data refer to gross weights, according to the definitions of the Harmonized Commodity Description and Coding System (Harmonized System) for trade classification. Additional detail has been presented in Table 1a to clarify whether the tonnage is nickel content or the weight of material shipped.

Inaccuracies in Trade Data

Canadian trade data are inaccurate with respect to the imports of nickel in concentrates. Statistics Canada data show import tonnages from Australia of 73 365 t of nickel in concentrates – this is many times higher than actual exports from Australia; it is likely that the import data show the tonnage of concentrates imported rather than the nickel content of the concentrates as the trade classification requires. The origin of the errors has not been determined and corrections are not available after six months of investigation. Instead, the INSG's data for Australian exports to Canada of 18 600 t of nickel in concentrates for 2002 and 11 765 t for 2001 are used in trade table 1a. The unit value of C$109.5 million is equivalent to US$69.7 million, which indicates a unit value of US$1.70/lb, roughly consistent with the figure of US$2/lb, which one can obtain by deducting the treatment and refining charges plus transportation expenses reported by Jubilee Mines from the average London Metal Exchange (LME) price for the period October 1, 2001, to September 30, 2002.

Data are not available on the 10 772 t of nickel in concentrates supposedly imported from the United States, which has no domestic nickel production, nor the 6179 t of nickel in concentrates reported to have been imported from Germany, another country with no domestic nickel production. Assuming these errors are similar to the Australian data, if the grade of the material shipped is assumed to be about 15% nickel, then the imports allegedly from Germany and the United States would have contained in the range of 2500 t of nickel. Alternatively, the trade may refer to material other than ores and concentrates.

Residues imported from Cuba are believed to be from the Moa leaching operation brought in for processing at the Fort Saskatchewan refinery. These residue imports totaled 62 000 t in 2002 valued at C$273 million. The tonnage and value are believed to reflect both the nickel and the cobalt content of these residues.

As noted in the 2001 chapter on nickel, a number of errors exist with respect to 2001 nickel in matte trade other than to Norway; these errors remain uncorrected.

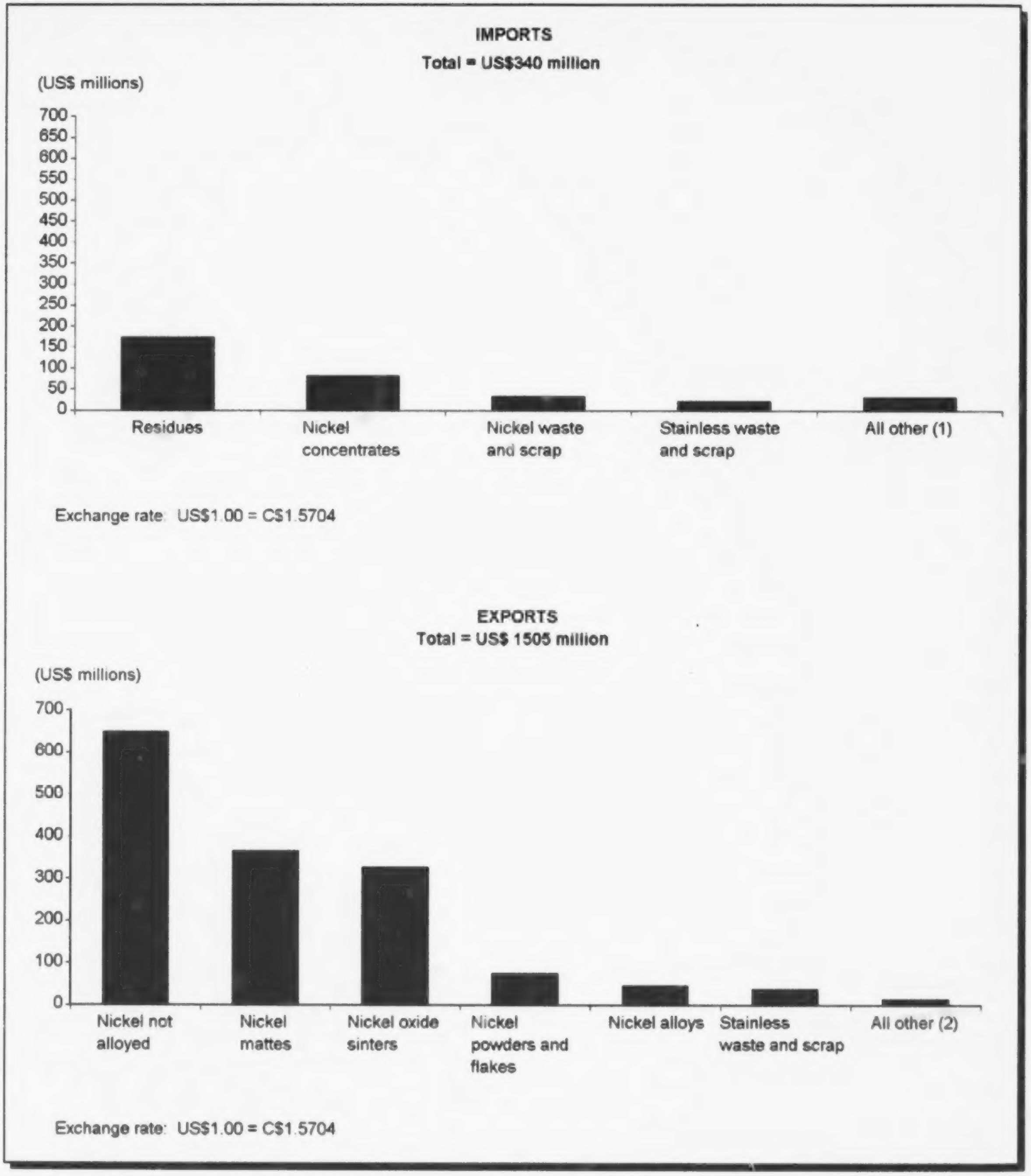
Table 1b provides an historical summary of nickel production and use from 1970 to date for selected years.

Additional trade information is also presented in Table 1c, which shows the total trade of cupro-nickel, nickel-silver, stainless steel, and nickel-containing batteries. These data do not show the weight of the contained nickel but, rather, the entire weight of the material; thus, stainless steel data show the weight of nickel plus iron plus chromium plus other alloying elements.

Canadian shipments of recoverable cobalt in concentrate from Canadian mines totaled 2027 t in 2002 compared to 2112 t in 2001. Refined cobalt production was 4303 t in 2002, compared to 4062 t in 2001. Table 2a provides cobalt production and trade data for 2001 and 2002. Note that the unit of measurement for the data in Table 2a is kilograms. Table 2b provides an historical summary of Canadian cobalt production and use from 1975 to 2002 for selected years.

Canada uses only a small amount of nickel compared to national production. A very large user of nickel in all

Figure 2
Canadian Nickel Trade, 2002



Exchange rate: US$1.00 = C$1.5704

Exchange rate: US$1.00 = C$1.5704

Sources: Trade values from Statistics Canada; graphed by Natural Resources Canada criteria.

(1) All other = unwrought nickel and alloys, sulphates, mattes, oxides, hydroxides, oxide sinters, chlorides and ferronickel.

(2) All other = nickel waste and scrap, sulphates, oxides, hydroxides and concentrates.

forms in Canada is Slater Stainless Corp., a subsidiary of Slater Steel Inc. Slater Stainless operates two facilities in Canada: a mill in Welland, Ontario, and a mill in Sorel, Quebec.

CANADIAN DEVELOPMENTS

There were four nickel and cobalt producers in Canada in 2002. In addition, Canmine Resources Corporation started commissioning its hydrometallurgical refinery at the end of 2001, but encountered financial difficulties by mid-year and was forced to close the refinery. It is likely that the Sudbury Basin Joint Venture (see below) will commence production in 2003. As noted earlier, Table 3 provides data on where to get additional information from the Internet for Canadian nickel-producing companies.

Table 4 provides summary details about Canadian nickel and cobalt production facilities in 2002. This table shows the type of output at each facility (e.g., nickel in concentrate is processed to nickel in matte, which is then processed to refined nickel, so counting all tonnages would triple-count production); therefore, the "production" data are not additive. For additional information about these facilities, readers can refer to the corporate web sites listed in Table 3, to the securities information available from the sources listed in Table 3, and to the "Nickel" chapter of the *2000 Canadian Minerals Yearbook* (www.nrcan.gc.ca/mms/cmy/content/2000/42.pdf), which presents a detailed review of Canada's nickel and cobalt production facilities in 2000.

Table 7 presents the capacities of nickel production facilities in Canada.

For more information about events during 2002, the reader may also examine the 2002 *Nonferrous Metals Outlook*, prepared in October 2002 and available on the Internet at www.nrcan.gc.ca/mms/pdf/nfo/nfo02/nick-e.pdf.

In addition, monthly Canadian nickel data are posted monthly at http://mmsd1.mms.nrcan.gc.ca/ mmsd/data/ default_e.asp. At this site, data are available in three file formats by month for:

- mine output (nickel content in concentrates produced);
- primary production (recoverable nickel in concentrates shipped);
- refined production (includes nickel in chemicals and in Class II forms); and
- domestic shipments of refined production.

All mine production in Canada is derived from the exploitation of nickel sulphide ores as Canada possesses no nickel laterite reserves. These sulphide ores yield important by-products such as copper, cobalt, gold, silver, platinum group elements, selenium, tellurium, sulphuric acid and liquid sulphur dioxide. Domestic mine production is supplemented by imported intermediate forms of nickel that are further processed in Canadian facilities; nickel in concentrates is imported into Canada from Australia to be processed in Canadian smelters, and nickel in nickel-cobalt sulphide residues is imported from Cuba, to name two examples. Conversely, some forms of nickel are exported for further processing in other countries; nickel matte is exported for further refining in Norway and nickel-copper intermediates are exported to the United Kingdom for the production of Class I refined nickel. Finished nickel contained in nickel oxide sinter is exported to Taiwan and South Korea for upgrading in those countries.

Mines

Falconbridge Limited, Inco Limited, and North American Palladium Limited own and operate 15 mines in Canada that produce nickel as either a primary product or as a by-product.

Falconbridge Limited operates four mines in the Sudbury area plus the Raglan mine in Quebec. The company produced 52 500 t of nickel in concentrates from its mines in 2002 compared to 59 800 t in 2001. The smelter produced 53 500 t of nickel in matte from primary sources and 4400 t of nickel from recycled sources in 2002, compared to 51 500 t and 3400 t, respectively, in 2001. It should be noted that production in 2001 was affected by a labour strike. The matte from the smelter is exported to Falconbridge Nikkelverk Aktieselskap, Falconbridge's refinery in Kristiansand, Norway.

Falconbridge's exploration work at the Nickel Rim South property resulted in the resource estimate being increased to 6.3 Mt grading 1.7% Ni, 3.4% Cu, 2.2 g/t Pt, 2.5 g/t Pd, and 1.5 g/t Au by year-end 2002. The company plans to decide by mid-2003 whether to proceed with shaft sinking and an underground exploration program. During the year, the possibility was raised that with the indefinite postponement of Inco's Victor program, that perhaps the Victor shaft could be utilized to advance the Nickel Rim South work more quickly. Falconbridge also added to its mineral inventory at its Fraser mine.

Falconbridge is scheduled to decide in 2003 whether to proceed with development of the Montcalm project near the company's Kidd copper-zinc operations in Timmins, Ontario. If approved, the property could yield 8000 t/y of refined nickel with initial production starting in late 2004. Capital expenses of about $63 million (about US$40 million) have been forecast for 2003 if the project proceeds. Ore would be milled at the Kidd operations and the concentrate would be sent to Sudbury for smelting. Indicated resources at Montcalm at year-end 2002 were 7 Mt grading 1.36% Ni, 0.67% Cu and 0.06% Co, plus inferred resources of 0.7 Mt grading 1.7% Ni, 0.70% Cu and 0.07% Co.

Inco Limited produced nickel from nine underground mines in Canada in 2002: seven located in Ontario and two in Manitoba. Sections of the former Frood mine in Sudbury are now operated as part of the Stobie mine. During 2002, Inco increased its production from lower-grade ores, including ore from the Gertrude mine, which was re-opened. The Ontario Division operated without a summer vacation and maintenance shut-down. Work to increase recovery rates at Inco's Clarabelle mill continued in 2002 with rates increased by 4.5%, or about 4500 t of nickel, during the year. Inco produced less nickel than was targeted due to ground control problems at the Creighton, Copper Cliff North and Stobie mines during the second half of the year and due to the maturity of the Thompson mine where stopes were smaller and grades were lower. The Thompson mine produced about 4500 t below target in 2002.

Development work at the Creighton deep mine project continued and production was 0.3 Mt grading 3.3% Ni and 2.3% Cu in 2002. A feasibility study was begun to examine the second phase targeted at 3 Mt grading 3.19% Ni and 3.12% Cu down to 2500 m below surface. Capital expenditures of US$47 million would be required in 2004 alone to develop the lower levels. At Inco's Garson mine, a decision was taken to deepen the mine, thereby extending its life from one year to nine years. Production will be increased from about 1900 t/d to nearly 2100 t/d by spending US$43 million to access 7 Mt grading 1.76% Ni, 1.36% Cu and 1.1 g/t PGMs plus Au located between 1360 m and 1550 m below surface. Dynatec Corporation won a $27 million contract to complete a 1000-m ventilation shaft at the Garson mine over a two-year period.

In 2002, development was undertaken at the Copper Cliff North mine's 138 orebody extension, targeted at higher levels of PGMs and gold. Exploration work in 2002 centred on: the Pump Lake deposit and the 191 orebody, both near the Copper Cliff North mine; the 830 orebody of the Copper Cliff South mine; a high-grade area at the Murray mine between 1200 and 1600 m below surface; and a new footwall zone at the McCreedy/Coleman mine. Subsequent to the agreement in principle to develop Voisey's Bay, Inco deferred indefinitely its Victor deep project, as noted above.

In an arrangement somewhat akin to those between WMC Resources Ltd. and various companies operating in the Kambalda area, an agreement between Inco and the Sudbury Basin Joint Venture (SBJV), owned by **FNX Mining Company Inc.** and **Dynatec Corporation**, became effective in January 2002. The SBJV purchased five properties from Inco, subject to certain conditions. The SBJV began a $14 million work program that includes drilling, development work, and various engineering and geological studies of the McCreedy West mine, the Levack mine, the Victoria mine, the Kirkwood mine and the Norman North PGM-Cu-Ni mineralized zone. Future production from these locations would be sent to Inco for milling, smelting and refining, subject to available capacity at Inco facilities.

At Inco's Manitoba operations, development of the lower Birchtree mine continued. The development will increase the output of Birchtree to partially offset the declining production from the mature Thompson mine where grades and stope sizes are declining. The production from the Birchtree mine created some operational difficulties for Inco due to a change in the magnesium oxide content of the Birchtree ore vis-à-vis Thompson ore, complicated by the increasing amount of imported Australian nickel concentrates from the Cosmos and Emily Ann operations. The continued imports of concentrates are designed to support Thompson's smelter and refinery output until concentrates from Voisey's Bay arrive, starting in 2006. The refinery was able to raise output of plating-grade nickel cathode to 94% of its output, up from 85% in 2001.

Inco has an agreement with **Nuinsco Resources Limited** whereby Nuinsco can acquire 100% in the Mel property by spending $6 million over a five-year period that ends August 31, 2004. Inco has an ability to re-acquire 51% under specific circumstances. Nuinsco's first goal is to outline a near-surface orebody of about 1 Mt grading 1.6-2% nickel that can be accessed and mined by a ramp.

North American Palladium Limited operates an open-pit palladium operation near Thunder Bay, Ontario. In 2001, the operation was expanded from 2400 t/d to 15 000 t/d at a cost of $220 million. Since that time, mineral processing difficulties in the mill and the crusher prevented the mine/mill from reaching its rated capacity. A new crusher is scheduled for completion by mid-2003 after which the operation is expected to operate at capacity. Nickel is one of the minor by-products of this operation and is contained in the concentrates that are sent to Inco and Falconbridge smelters in Sudbury for processing. Production in 2002 was 1254 t of nickel, up from 724 t in 2001.

Nickel Processing

Inco and Falconbridge Limited operate smelters in Canada; three are located in Sudbury, Ontario, and one is located in Thompson, Manitoba. Inco Limited and Sherritt International Corporation operate the processing facilities that produce Class I and Class II[3] nickel in Canada. A third company, Canmine Resources Corporation, owns a refinery capable of producing cobalt and nickel salts, but the refinery was put on standby in 2002 due to corporate financial difficulties.

Falconbridge Limited operates an electric smelter in the Sudbury area. This facility processes nickel, copper and cobalt in concentrates from its nickel mines in Canada and also processes nickel and cobalt from recycled sources. In 2002, the smelter produced 57 854 t of nickel in matte of which 4400 t was from recycled material.

Inco Limited operates two flash smelters at Sudbury that process bulk nickel-copper-cobalt concentrates. Inco's smelter throughput was increased to 4300 t per day during the year. The matte is slow cooled and then crushed, milled and processed by flotation to produce separate nickel concentrate and copper concentrate. Inco does all of its copper concentrate smelting and refining in Sudbury, including small amounts of copper concentrate shipped from Inco's Thompson operations.

Nickel separated from the copper in matte processing is either sent to a carbonyl refinery in the Sudbury basin where nickel pellets and powders and ferronickel pellets are produced, or it is sent as an intermediate nickel-copper oxide to Inco's carbonyl plant at Clydach in Wales, United Kingdom, for processing to refined nickel. Residues from Clydach are returned to Sudbury for further processing to recover copper and precious metals.

Inco groups its Sudbury and Clydach refineries into one division, reporting the production from these facilities as "Ontario" production. Production of the Ontario division in 2002 was 226 million lb or about 102 500 t. Subtracting the Clydach nickel output of 33 800 t for 2002,[4] the estimated output of refined nickel and nickel in nickel oxide sinter was 68 700 t in 2002.

In Thompson, Inco produces electrolytic nickel in an electro-refinery. Plating-grade nickel with its higher premium is the major output of this operation, accounting for 94% of the refined output in 2002. As noted above, Inco experienced problems at the smelter during the year due to high levels of magnesium oxide.

The Inco and Falconbridge smelters in Sudbury were affected by a new Control Order issued in February 2002 by the Ontario government. The order reduced permissible ground-level concentrations of sulphur dioxide by 34% to 0.34 ppm as of April 1, 2002. As well, the Control Order cut the allowable annual emission limits for both companies by 34% effective December 31, 2006. The Province requires the companies to report annually to the government and the public on research and development investigations into the technological and economic measures possible to further reduce emissions of sulphur dioxide. A final report is due December 31, 2010. Falconbridge's emissions in 2002 were well below the new annual emission limit to be instituted in 2007. Inco intends to meet the new targets by installing scrubbers in the SO_2 off-gas emissions from the fluid bed roaster at a cost of US$76 million. The scrubbing will also reduce metal emissions and increase sulphuric acid production.

The tonnages of SO_2 emissions by nickel smelters in Canada in 2002 and 2001 were:

	2002	2001
• Falconbridge Sudbury	38 300	29 600[5]
• Inco Sudbury	243 000	232 000
• Inco Thompson	210 000	217 000

Sherritt International Corporation operates a joint venture with the Cuban government (50:50 ownership) called Metals Enterprise. Metals Enterprise operates a nickel laterite mine and acid pressure leach plant at Moa Bay in Cuba that ships nickel-cobalt sulphide residues to the joint venture's hydrometallurgical refinery at Fort Saskatchewan, Alberta. The Cobalt Refinery Company Inc., owned by Metals Enterprise, operates the hydrometallurgical refinery, which gets most of its nickel feed from the imported nickel-cobalt residues. During 2002, the refinery produced 31 694 t of nickel (and 3065 t of cobalt), record production for the plant. The hydrometallurgical plant produces nickel and cobalt powders and briquettes. In addition, the plant produces ammonium sulphate fertilizer.

Canmine Resources Corporation owns a hydrometallurgical cobalt-nickel refinery in Cobalt, Ontario, and a number of mineral properties, including a nickel-copper-cobalt property in Manitoba and the Werner Lake cobalt property in Ontario near the border with Manitoba. In December 2001, Canmine started the commissioning of the refurbished refinery, progressing by April 2002 to start the commissioning of the autoclave section. By July, after producing initial product, financial pressures forced the company to suspend operations at the refinery. The company sought protection under the *Companies Creditors Arrangement Act* to enable it to restructure. The restructuring was still in progress by year-end and the refinery remained on care-and-maintenance status.

Voisey's Bay Project

In June 2002, Inco Limited and the Province of Newfoundland and Labrador agreed upon the principles for the development of the Voisey's Bay nickel deposit, located on the coast of Labrador. In May 2002, Inco's subsidiary, **Voisey's Bay Nickel Company Limited** (VBNC), reached separate agreements with two Aboriginal groups; these groups then ratified the agreements in July 2002. In October, the Province and VBNC released their definitive agreements, dated September 30, 2002, to implement development of the project. Complete details of the Voisey's Bay Employment and Industrial Benefits Agreement and the Voisey's Bay Development Agreement are available (14-Mb file) at www.sedar.com/csfsprod/data33/filings/0048530/00000001/%3A%5CINCO%5C2002%5C8Koct8.pdf. Information from the provincial government is available through links located at www.gov.nf.ca/voiseys.

As a consequence of the completion of the arrangements required to develop Voisey's Bay, Inco was able to evaluate the carrying value of the project. This resulted in a write-down of US$1.5 billion net of deferred taxes of the carrying value of the asset to US$2.2 billion.

Briefly, the agreements include[6]:

- initial work worth at least $35 million at the mine site and at Argentia to be undertaken by March 31, 2003;
- a $130 million R&D program, including a pilot plant at Argentia to be completed by December 31, 2006, with no nickel concentrate shipments from the province to occur before completion of the pilot plant or before shipments of concentrate to the pilot plant;
- a $170 million mine, concentrator and infrastructure to be built from 2003 to 2006 capable of producing 6000 t/d of ore into nickel and copper concentrates providing 400 jobs; production to be limited to 2.2 Mt/y of ore for the first 10 years of mine production and to 5.5 Mt/y of ore thereafter;
- copper concentrate may be shipped outside the province unless sufficient quantities are discovered to warrant processing facilities or construction of a processing facility by a third party;
- nickel concentrate may be shipped outside the province after completion of a pilot plant at Argentia until the earlier of: a total of 355 000 t of contained nickel in concentrates shipped, or completion of the hydrometallurgical plant, or there is no decision about a hydrometallurgical plant by November 15, 2008; after completion of a hydrometallurgical plant, up to a further 85 000 t of contained nickel in concentrates may be shipped out of the province until the commercial production date of the hydrometallurgical plant (defined as an annualized production rate of 30 000 t/y of a nickel product containing at least 99.8% Ni for a period of 90 days);
- before mining ceases, shipment of nickel in intermediates to commence at a rate yielding not less than 25 000 t/y of finished nickel products (at least 99.8% Ni content) and must continue until the total tonnage of nickel plus cobalt shipped into the province is equal to the total tonnage of nickel plus cobalt contained in concentrates shipped out of the province;
- a $20 million advanced surface exploration program to be conducted between 2002 and 2006 as part of a $95 million exploration program designed to define sufficient reserves to permit expansion of the mine and concentrator;
- a $750 million expansion of the concentrator and construction of an underground mine providing 800 jobs, designed to keep the hydrometallurgical plant operating at full capacity;
- the decision about the processing plant (hydrometallurgical plant or the matte processing plant) is to be made by November 15, 2008, with plans delivered to the government by December 31, 2008, so that the plant is built by December 31, 2011; the $800 million hydrometallurgical plant, built over three years, is to produce approximately 50 000 t/y of nickel products of at least 99.8% Ni and provide 400 jobs; a matte-processing plant would be built if the hydrometallurgical plant is technically unfeasible such that the matte plant would produce approximately 50 000 t/y of nickel products grading at least 99.8% Ni; and
- the Province granted the mining lease to Voisey's Bay on September 30, 2002, subject to various conditions.

Inco's Annual Report for 2002 described the federal government's involvement in the region as:

> "the Government of Canada is making available up to C$150 million from its existing programs to support activities in and around the Voisey's Bay project as they relate to innovation, training and business development opportunities for Aboriginal people."

A government press release and details about the relevant programs of four government departments can be found on the Internet at www.acoa.gc.ca/e/media/press/press.shtml?1813.

WORLD NICKEL PRODUCTION

Table 5 shows a list of world nickel producers and their web sites, where available. Table 6 provides information about world nickel producers for 2002. Tables 8 and 9 show selected mine production and primary production data for nickel, respectively.

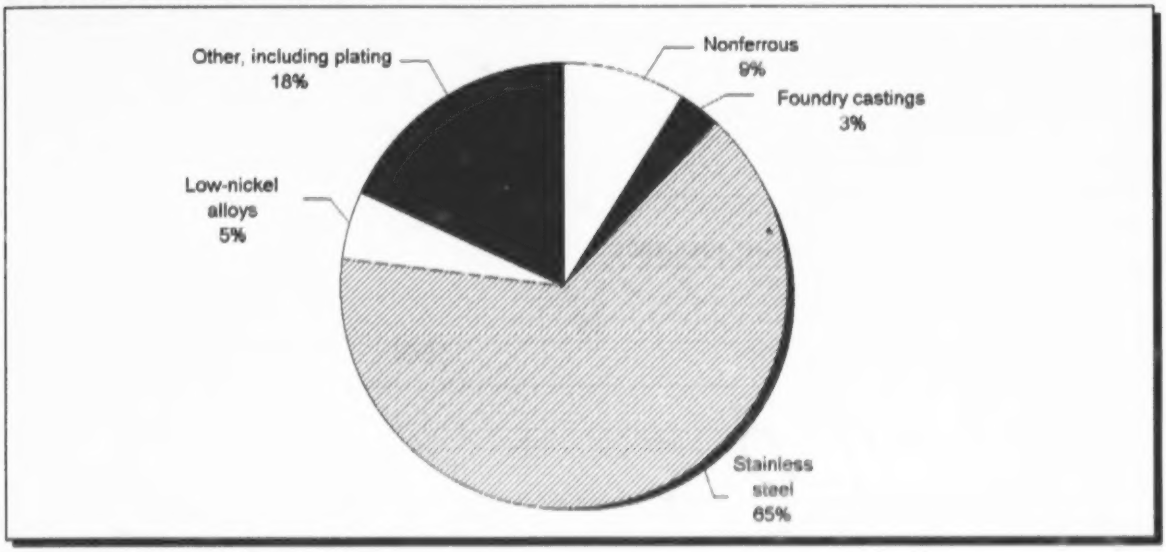
WORLD COBALT PRODUCTION

World cobalt mine and metal production data by country from the International Consultative Group on Nonferrous Metals Statistics for the period 1991 to 2000 were presented in Figures 3 and 4 of the Nickel chapter in the 2000 *Canadian Minerals Yearbook* (www.nrcan.gc.ca/mms/cmy/content/42.pdf). Table 13 presents CDI information about cobalt availability by company for the period 1997-2002.

NICKEL USE

The important world markets for primary nickel are shown in Figure 3. In addition to the 1.17 Mt of primary nickel used in 2002, there were approximately 600 000 t of nickel contained in stainless steel scrap used by stainless steel mills in 2002.

Figure 3
Western World Plus China Nickel Use, 2002



Source: Inco Limited's 10K report, 2002.
Notes: Western World excludes the Russian Federation, Cuba, the former Eastern Europe and the C.I.S. About 78% of stainless steel is estimated to be nickel-containing.

Stainless steel production in 2002 was reported by the International Stainless Steel Form (ISSF)[7] as 20 Mt in 2002, up from 19 Mt in 2001. *Metal Bulletin's* weekly stainless steel prices[8] for Grade 304 CR coil 2B c.i.f. East Asian port increased from US$1180/t to US$1590/t over the course of the year.

COBALT USE

Information about cobalt uses can be obtained from The Cobalt Development Institute's Internet site at www.thecdi.com (click on "about cobalt"), the U.S. Geological Survey's Internet site at http://minerals.usgs.gov/minerals/pubs/commodity/cobalt, and the OM Group Inc.'s Internet site at www.omgi.com.

On the OM Group site at www.omgi.com/industries/default.htm, there is a list of applications; each title can be clicked on for more information about the specific application of cobalt and nickel as well as other OMG products. Canadian cobalt use is reported in Table 2b.

RECYCLING, HEALTH AND THE ENVIRONMENT

Health and environmental issues related to nickel are examined briefly in a general fact sheet on nickel that is available on the Internet at www.nrcan.gc.ca/mms/cmy/mfs_e.htm.

To calculate a recycling rate, one needs to know the product life for the materials used in goods. Stainless steel is used in relatively long-life applications due to its higher initial cost and lower maintenance costs over its years in service. So this means that there is a long period of time between production of the nickel-containing stainless steel and its recycling. But, during that time, demand and production grow. At a 6% growth rate, stainless steel demand more than quadruples in 25 years. If all the nickel in the stainless steels produced in one year were to be recycled after 25 years, the recycling of 100% of that material would only represent 25% of the nickel being used to make stainless steel. Therefore, in this case, 100% recycling would translate into a feed ratio of only 25% recycled material if all scrap were sourced only from used consumer and industrial goods (i.e., "old" scrap). Thus, one can conclude that recycling rates are higher than the ratio of recycled feed to total feed; calculating the true recycling rate is difficult because of the varying product lives that contain nickel.

PRICES AND INVENTORIES

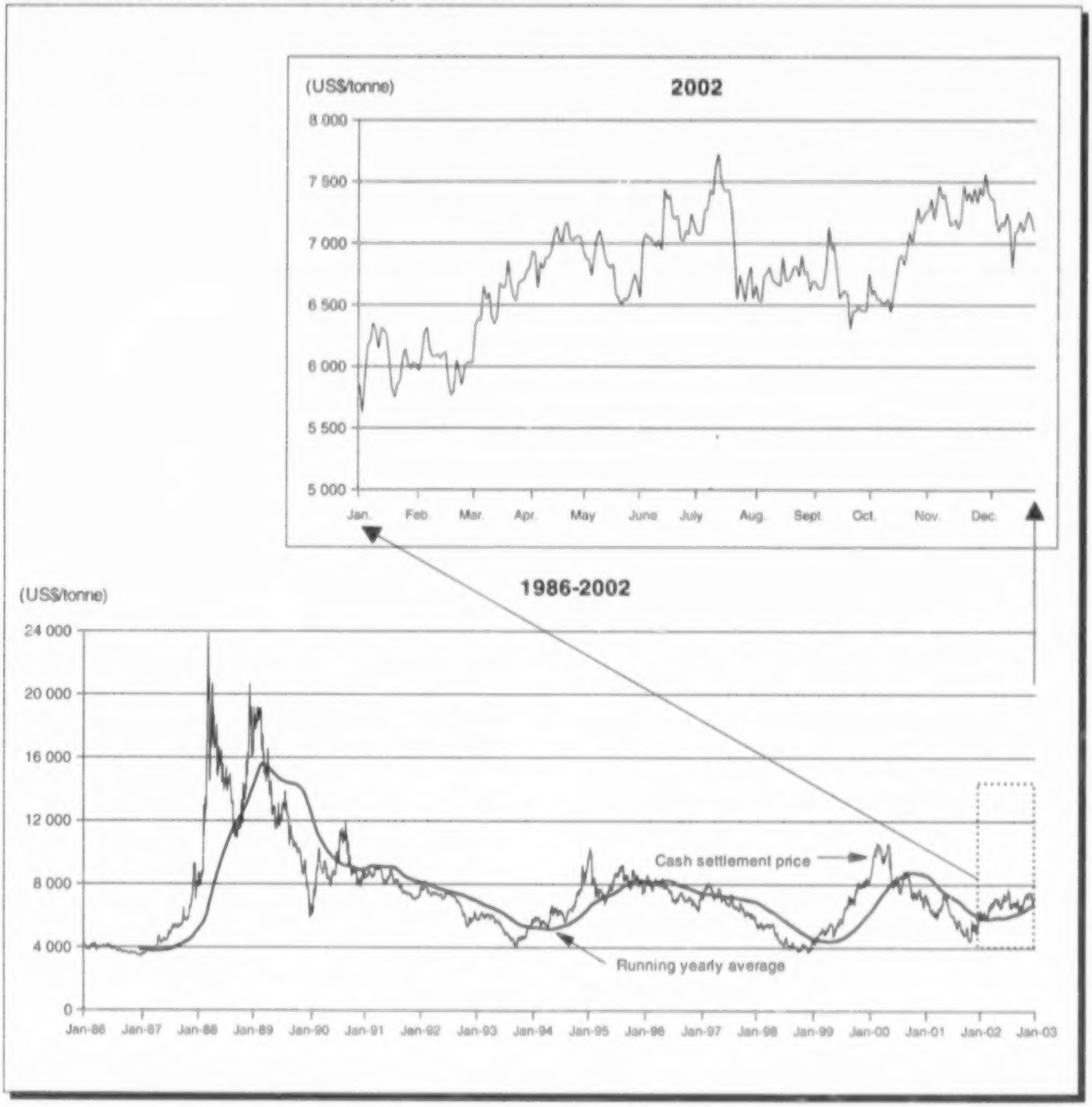
Figure 4 shows prices in 2002 and for the period 1986-2002. Inventories on the LME rose from 19 600 t[9] at the start of 2002 to 24 500 t by late January, declined to 16 600 t by mid-April, rose sharply to 29 100 t in June, and then drifted down to recover to nearly 22 000 t by year-end.

Current and historical nickel prices and inventories are available on the LME's Internet site at www.lme.co.uk. Other sites for nickel prices and inventories include www.metalalloys.com, www.metalbulletin.com and www.inco.com/products/marketwatch/default.asp.

Cobalt

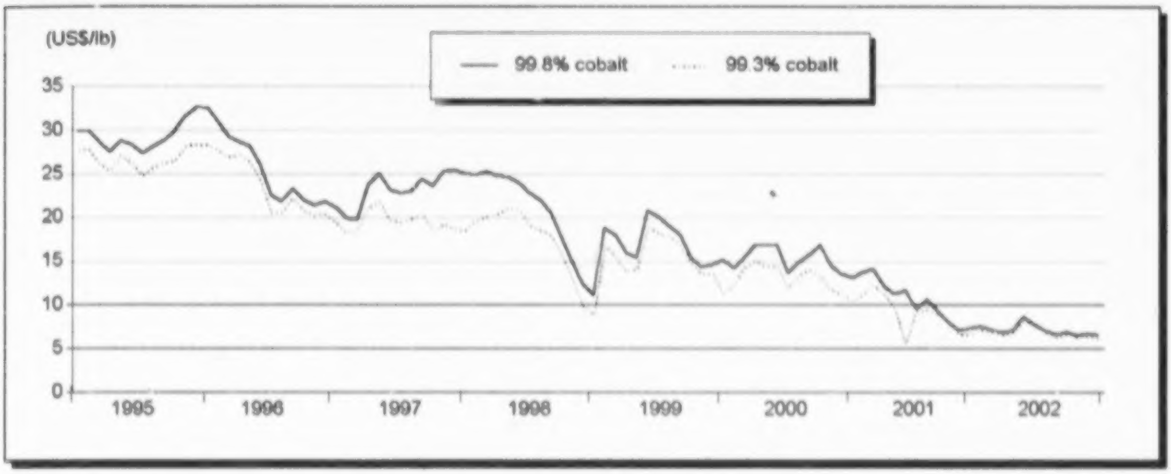
Monthly cobalt prices are shown in Figure 5. No terminal markets such as the LME exist for cobalt, although WMC

Figure 4
LME Cash Settlement Nickel Prices, 1986-2002



Sources: International Nickel Study Group; Reuters; World Bureau of Metal Statistics.
Conversions: $2.50/lb = $5512/t; $3.00/lb = $6614/t; $3.50/lb = $7716/t; $4.00/lb = $8818/t.

Figure 5
Cobalt Prices, Average of Metal Bulletin Monthly Average High and Low Prices, 1995-2002



Source: *Metal Bulletin*

Limited reports trading on its Internet site at www.wmc-cobalt.com/sales.asp. OMG's web site at www.omgcobalt.com does not show trades after September 30, 2002.

OUTLOOK

Delays

A number of projects continued to await financing or were delayed. In December, Inco announced that its Goro project was being put on hold while the company carried out a complete review. This followed Inco's news release of a possible 30-45% increase in the $1.45 billion capital cost estimate for Goro (i.e., to the range of US$15.50-$17.50/lb of annual capacity of nickel production). This followed an earlier announcement in October that the project costs could run 15% over the US$1.45 billion estimate. Geotechnical issues and process plant and infrastructure costs were each identified as contributing about US$250 million to the potential cost increases. Inco put the delay at a minimum of six months, which would delay startup until at least the second half of 2005. Inco's target is to obtain a rate of return at least equal to the corporate weighted average cost of capital of between 9 and 10%. Inco reported spending US$385 million on Goro as of year-end with a further US$260 million committed.

Other projects that did not advance during the year included:

- Gag Island, Indonesia – Falconbridge Limited announced in January that it had terminated its agreement with BHP Billiton with respect to a potential joint venture to develop the deposit, due in part to unresolved forestry issues.

- Ramu project, Papua New Guinea – Highlands Pacific Limited and Orogen Minerals (Ramu) Limited were still engaged at year-end in lawsuits against each other with respect to Orogen's decision to withdraw from the project partnership. Details about the Ramu project are available on the Internet at www.highlandspacific.com/projects/ramu/index.shtml.

- Ravensthorpe/Yabulu project, Australia – BHP Billiton continued its studies of the front-end leaching plant at the future Ravensthorpe mine and the modifications to the Yabulu hydrometallurgical refinery in Queensland.

- Weda Bay, Indonesia – OM Group terminated its agreement with Weda Bay Minerals, Inc. and ceased funding a bankable feasibility study of a project designed to produce up to 30 000 t/y of Ni and 3000 t/y of Co in intermediate forms.

Intermediate Trade

Intercorporate trade in nickel intermediates exists, often the result of investment in producing facilities. Example of this include:

- a share of matte from PT International Nickel Indonesia shipped to Sumitomo's refinery in Japan;
- OMG's nickel cobalt hydroxide exports from its Australian plant at Cawse shipped to its refinery in Finland;
- PT International Nickel Indonesia's shipments to Inco TNC in Japan and to Sumitomo Metal Mining Co., Ltd.;
- SLN's shipments of matte from New Caledonia to Eramet's Sandouville operation;
- nickel concentrate imports by Outokumpu's smelter in Finland from the MPI/OMG mine in Australia, which in turn is sent to OMG's refinery beside the smelter;
- future output by Coral Bay Nickel (in which Sumitomo has a share) in the Philippines to be shipped to Sumitomo's refinery in Japan.

Compared to the copper and zinc industries, there is relatively little intermediate nickel sold or tolled between companies that is not the result of investment in projects. In the nickel industry, the "non-investment" transactions include:

- BCL matte from Botswana toll refined in Norway and Zimababwe;
- concentrates from Cosmos and Emily Ann in Australia imported by Inco for its Canadian operations, although Inco purchased stock in the companies that own both of these concentrate-producing mines;
- WMC Resources' matte sales from Australia to OMG in Finland, to Sumitomo in Japan, and more recently to Jinchuan Nonferrous Metals Corporation in China; and
- OMG's imports of nickel matte into Finland from Rio Tinto's Fortaleza smelter in Brazil.

It appears that there will be more potential for more arm's length trade in intermediate forms of nickel than in the past as companies and their financers may opt to reduce project risk and costs by avoiding the refining stage. With existing refineries able to reduce unit costs with higher throughputs, combined with projects seeking to reduce project costs and technical risk, the present high price phase of the price cycle may result in a proliferation of intermediate nickel producers and, hence, trading. Various projects exist that await financing such as Ramu in Papua New Guinea or Weda Bay in Indonesia. Jinchuan appears eager to import nickel concentrates and matte to boost production at its smelter/refinery in China, having concluded an agreement with Sally Malay in the latter half of 2002 and later with WMC Resources. Rio Narcea concluded a financing agreement in late 2002 for an operation to produce up to 10 000 t/y of nickel in concentrates.

Overbuilding Stainless Capacity

The expansion programs in the stainless steel industry continued in 2002. After increasing production from an estimated 18.7 Mt in 2001 to 20.3 Mt in 2002, future production is projected at about 23 Mt by 2005. There are indications that the nickel industry will not be able to supply sufficient nickel feed to the stainless industry from perhaps as early as mid-to-late 2004 and for a couple of years thereafter. This overcapacity has the potential to have more serious consequences for the nickel and stainless steel industries than have past expansions.

If the nickel industry overbuilds capacity, that will lead to lower prices and reduced revenue for the nickel industry, which in turn will cause industry hardship and curtailment of operations or cancellation of expansions. However, in this case, the projected stainless capacity exceeds the ability of the nickel industy to supply sufficient nickel. Without nickel, not all austenitic producers will be able to make their products – this means that some stainless producers will not be able to produce and therefore will have no revenue.

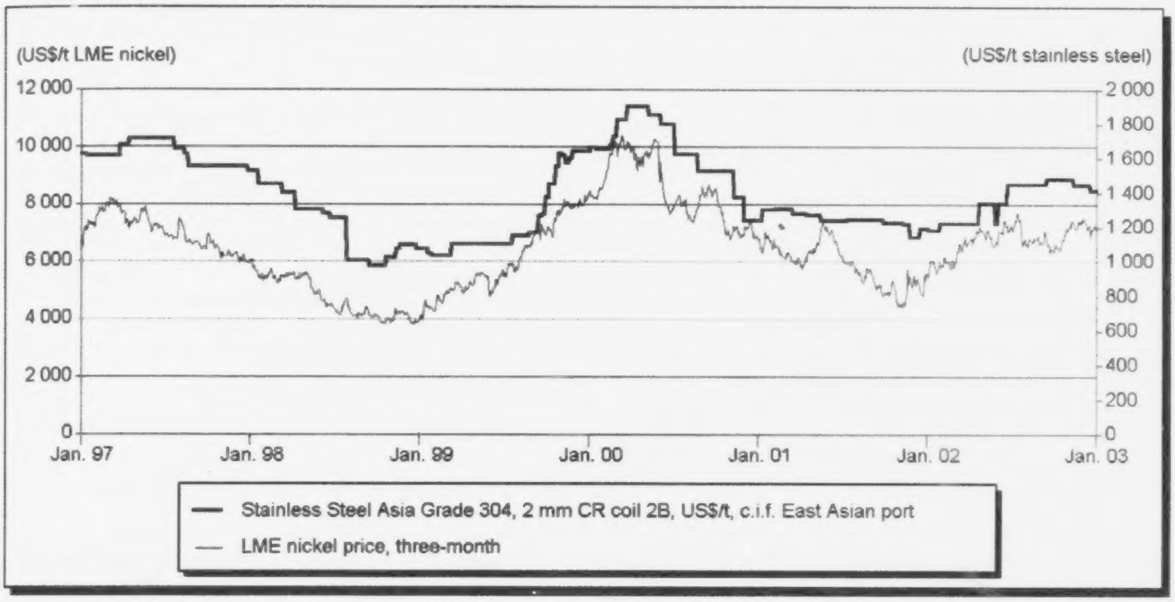
It is expected that stainless producers will first seek to contract for sufficient nickel to keep their operations in business. However, at some point, when the operating throughput of the stainless plants exceeds the nickel supply after the nickel stocks have been exhausted, some stainless plants will be faced with two choices: either to shut down or to produce stainless steel with less or no nickel.

As nickel prices are bid higher and higher as supply declines, changes in some product lines will take place. These include:

- substitution of nickel by other alloying elements;
- substitution of nickel-bearing stainless steel by other materials; and
- a reduction in the amount of nickel used in some stainless applications.

In some markets, stainless usage may be relatively insensitive to increased prices for nickel. But the prospect of years of high stainless prices caused by high nickel prices due to insufficient supply will sow the seeds of the next market correction for nickel. Stainless steel may acquire

Figure 6
Nickel and Stainless Steel Prices, 1997-2002



Source: *Metal Bulletin*.

the reputation of an "expensive" material, moderating future demand growth in the medium term. Concurrently, continued high prices may permit a new wave of laterite investments. This could be exacerbated by a rush to be among the "first into production" and benefit from the high prices of nickel. (One recalls the race to beat Voisey's Bay into production in the late 1990s and its consequences.)

The outlook for nickel demand is a function of the industrial activity of the major countries in the world. The largest user of nickel, both primary and recycled, is the stainless steel industry, whose use is strongly correlated with indices of industrial production (see the Nickel chapter of the 1999 *Canadian Minerals Yearbook*, Figure 5, for a graph illustrating the relationship).

The demand for primary nickel is expected to grow at an average trend rate of 3%/y or less during the next decade. The actual demand in any year will vary about the trend due primarily to changes in world industrial activity, which cause changes in stainless steel demand. It is suggested that high growth rates for austenitic[10] stainless steel would increase nickel prices; a sustained period of prices in the US$8500/t range (or US$9500/t, allowing for a weakened U.S. currency) would decrease the competitiveness of a significant portion of austenitic stainless steel production.[11] Unless new lower-cost production came on stream, the higher nickel prices would lead to decreased demand growth for nickel. It appears that prices will remain at historically high levels in the short term because new projects have been delayed and because the stainless steel industry continues its massive capacity increase.

The December 1998-November 2001 price cycle that peaked in March 2000 at US$10 660/t did not result in new nickel production capacity building following this peak, as had occurred when prices improved in earlier price cycles. Part of the reason for the lack of enthusiasm by potential new entrants to the nickel industry in times of high prices was due to the legacy of the laterite debts. Lenders and bond holders for two Australian projects, Cawse and Bulong, were disappointed at the inability of these projects to service debt. At the end of 2001, Anaconda Nickel Limited, operator of the third Australian project, reported a loss of A$458 million, largely due to writeoffs.

In general, the amount of new production capacity scheduled to come on stream in the next five years is regarded as insufficient to meet the expected growth rate in stainless steel production. This implies that the growth in stainless steel production will not be as high as expected with higher nickel prices retarding stainless steel demand.

It seems increasingly likely that the U.S. currency value will decline relative to other major currencies, so the nominal prices in U.S. dollars may increase more than the prices in Euros, as an example. If the Canadian dollar appreciates relative to the U.S. dollar, this will pose a challenge to Canadian producers who have many of their costs denominated in Canadian currency. Nickel prices are not expected to vary with the rates of inflation expected; technological advances are expected to more than overcome inflationary pressures.

Cobalt

Cobalt prices (Figure 5) continued their downward trend, due less to increasing nickel production from nickel-cobalt deposits in 2001 than to the downturn in aerospace demand following the terrorist attack in the United States. The expectation is that decisions to proceed with a number of new hydrometallurgical nickel-cobalt laterite plants would further depress cobalt prices in the medium term. However, a lower price would allow cobalt to be used economically in other applications for which it is presently too expensive. The high prices of the mid-1990s would be very difficult to sustain in the future, given present conditions and expectations.

ADDITIONAL SOURCES OF INFORMATION

Readers may access various additional sources of information on the Internet to obtain more details about nickel in general. A search engine, such as Google (www.google.com/ advanced_search) is a good way to start. A few sites for additional information include:

Natural Resources Canada
Canadian Minerals Yearbook:
www.nrcan.gc.ca/mms/cmy/pref_e.htm
Metal and mineral statistics:
http://mmsd1.mms.nrcan.gc.ca/mmsd/minstatistics_e.asp
Nickel production by month:
http://mmsd1.mms.nrcan.gc.ca/mmsd/data/default_e.asp
Production by province and territory:
http://mmsd1.mms.nrcan.gc.ca/mmsd/production/production_e.asp

Physical/Chemical Properties of Nickel
www.webelements.com/webelements/elements/text/Ni/key.html

Physical/Chemical Properties of Cobalt
www.webelements.com/webelements/elements/text/Co/key.html

WMC Market News and Commentary
www.wmc-nickel.com/news.asp
The site provides market information and industry developments (hundreds of items of market information for 1999 onward); however, entries of information seem to terminate in late June 2002.

International Nickel Study Group
www.insg.org

U.S. Geological Survey
Comprehensive commodity reviews:
http://minerals.usgs.gov/minerals/pubs/commodity

Yahoo Search of Mining News
http://s6.news.dcn.yahoo.com/search/news
(Put the word "nickel" into "Your Search.")

ENDNOTES

[1] The preliminary mine production number for 2001 was reported last year as 193 361 t.

[2] Data for 2002 are shown in the sentences; numbers in parentheses indicate data for 2001.

[3] As defined by the INSG, Class I nickel contains 99% or more nickel; Class II nickel refers to products with a content of less than 99% nickel and can include nickel in ferronickel, nickel oxide sinter, utility nickel, etc.

[4] Clydach output in 2002 taken as INSG reported production of refined nickel in the United Kingdom of 33 800 t.

[5] Falconbridge smelter operations were affected by a labour strike for part of 2001.

[6] The reader should refer to the web reference for the actual wording of the agreement in its entirety, including the definitions of specific terms for purposes of the agreement; the information listed above is not all inclusive and does not necessarily use the language and terms of the agreement. It is intended only to provide general information.

[7] ISSF web site is at www.worldstainless.org/ix.php.

[8] The average of the weekly high and weekly low price as reported by *Metal Bulletin*.

[9] Inventories rounded to nearest 100 t.

[10] Austenitic stainless steels contain nickel whereas ferritic stainless steels do not.

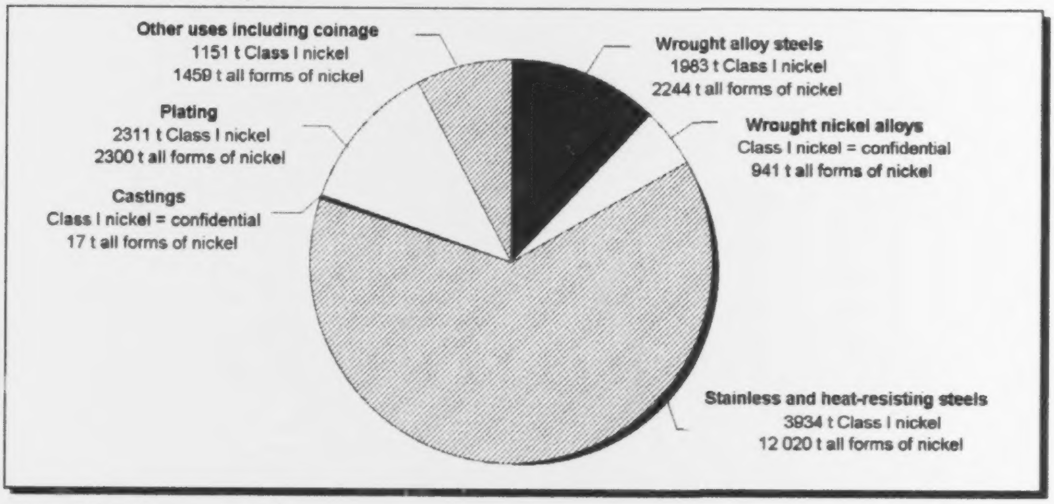
[11] Not all uses of austenitic stainless steels are equally at risk of substitution; some applications are thought to be quite insensitive to substitution.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 30, 2003. (3) Various Internet sites have been identified in this article. Please note that Natural Resources Canada has no control over the content of the web sites of other organizations, which may be modified, updated or deleted at any time. (4) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

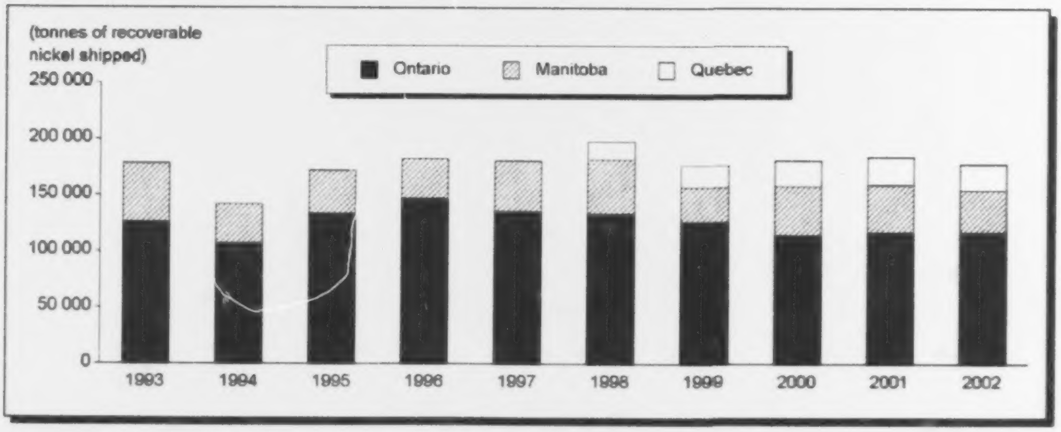
The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 7
Canadian Nickel Use, 2002



Source: Natural Resources Canada.
Note: Chart reflects total nickel use, including nickel in scrap.

Figure 8
Canadian Nickel Shipments, 1993-2002



Source: Natural Resources Canada.

TARIFFS

		Canada			United	EU	Japan (1)	Brazil	India	Taiwan	Korea (2)
Item No.	Description	MFN	GPT	USA	Canada	MFN	WTO	MFN	MFN	MFN	MFN
2604.00	Nickel ores and concentrates	Free	Free	Free	Free	Free	Free	3.5%	5%	Free	1%
2825.40	Nickel oxides and hydroxides	Free	Free	Free	Free	Free	4.8%	3.5-11.5%	30%	2.5%	8%
7202.60	Ferro-nickel	6.5%	Free	Free	Free	Free	3.3%	7.5%	25%	Free	3%
7501.10	Nickel mattes	Free	Free	Free	Free	Free	Free	7.5%	15%	Free	1%
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy	Free	Free	Free	Free	Free	Free-44 yen/kg (3)	7.5%	15%	Free	1-2%
7502.10	Unwrought nickel, not alloyed	Free	Free	Free	Free	Free	44 yen/kg	7.5%	15%	1.00%	3%
7502.20	Unwrought nickel alloys	Free	Free	Free	Free	Free	Free-3% (4)	7.5%	15%	1.00%	3%
7503.00	Nickel waste and scrap	Free	Free	Free	Free	Free	Free	3.5%	15%	Free	1%
7504.00	Nickel powders and flakes	Free	Free	Free	Free	Free	Free-41 yen/kg-3%	7.5%	15%	Free	5%
7505.11	Bars, rods and profiles of nickel, not alloyed	Free	Free	Free	Free	Free	3%	13.5%	15%	2.5%	5%
7505.12	Bars, rods and profiles of nickel alloys	Free	Free	Free	Free	2.90%	3%	13.5%	15%	2.5%	5%
7505.21	Nickel wire, not alloyed	Free	Free	Free	Free	Free	3%	13.5%	15%	1%	5%
7505.22	Wire of nickel alloys	Free	Free	Free	Free	2.90%	3%	13.5%	15%	1%	5%
7506.00	Nickel plates, sheets, strip and foil	Free	Free	Free	Free	Free-3.3%	Free-3%	13.5%	15%	2%	5%
7507.00	Nickel tubes, pipes, and tube or pipe fittings	Free	Free	Free	Free	Free-2.5%	Free-3%	15.5%	15%	2%	8%
7508.00	Other articles of nickel	Free-3%	Free	Free	Free	Free	3%	17.5%	15%	1-4.3%	8%

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Brazil* (9th Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of India* (9th Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Korea* (9th Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Taiwan* (7th Annual Edition: 2002); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for Japan* (36th Annual Edition: 2002).

(1) WTO rate is shown; lower tariff rates may apply circumstantially. (2) South Korea. (3) Free except for nickel oxide sinters containing by weight not less than 88% nickel, for which the tariff rate is 44 yen/kg, and nickel oxide containing by weight not more than 1.5% copper, for which the tariff rate is 3%. (4) The tariff rate of 3% applies to nickel alloys other than those containing by weight less than 50% nickel and not less than 10% cobalt.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2605.00	Cobalt ores and concentrates	Free	Free	Free	Free
2822.00	Cobalt oxides and hydroxides, commercial cobalt oxides	Free	Free	Free	Free
2827.34	Cobalt chloride	4%	3%	Free	Free
2833.29.00.40	Cobalt sulphate	Free	Free	Free	Free
2836.99.10.30	Cobalt carbonates for use in the manufacture of animal or poultry feeds, glues or adhesives, optical fibres or optical fibre bundles or cables, typewriter or similar ribbons, polymers in primary forms or profile shapes or sheets of plastics; cobalt carbonates to be employed as drilling mud or additives therefor in drilling for minerals, natural gas, oil or water	Free	Free	Free	Free
2836.99.90.20	Other cobalt carbonates	3.5%	3%	Free	Free
2915.23.10	Cobalt acetates for use as petroleum refining catalysts, or for use in the manufacture of animal or poultry feeds, glues or adhesives, optical fibres or optical fibre bundles or cables, typewriter or similar ribbons, polymers in primary forms or profile shapes or sheets of plastics	Free	Free	Free	Free
2915.23.90	Other cobalt acetates	6.5%	3%	Free	Free
8105	Cobalt mattes and other intermediate products of cobalt metallurgy; cobalt and articles thereof, including waste and scrap; unwrought cobalt; powders				
8105.20.10	Powders; unwrought cobalt, not alloyed	Free	Free	Free	Free
8105.20.90	Other	3%	Free	Free	Free
8105.90.10	Cobalt bars and rods, not alloyed	3%	Free	Free	Free
8105.90.90	Cobalt and articles thereof, n.e.s.	3%	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003.
n.e.s. Not elsewhere specified.

TABLE 1a. CANADA, NICKEL PRODUCTION AND TRADE, 2001 AND 2002

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
MINE OUTPUT	Nickel content of concentrates produced	194 058	. .	187 791	. .
SHIPMENTS	Recoverable content of nickel in concentrates shipped from Canadian mines				
	Quebec	24 417	235 480	23 280	245 837
	Ontario	117 140	1 129 694	117 406	1 239 812
	Manitoba	42 743	412 215	37 652	397 602
	Total Canada	184 300	1 777 389	178 338	1 883 250
	Finished nickel output = refined nickel in various shapes in Class 1, plus Class II nickel (as defined by the International Nickel Study Group), which includes nickel oxide sinter	140 591	. .	144 476	. .
EXPORTS					
2604.00.40	Nickel ores and concentrates (nickel content)				
	United States	6	39	. . .	4
2825.40	Nickel oxides and hydroxides (weight of material, not nickel content)				
	Hong Kong	409	4 573	234	2 193
	China	91	969	126	1 203
	United States	120	1 134	164	1 052
	Singapore	60	615	64	587
	Japan	11	128	62	250
	Sweden	149	527	64	228
	Brazil	2	43	4	90
	Malaysia	8	77	8	80
	Saint Lucia	–	–	19	29
	Norway	–	–	2	22
	France	1	10	–	–
	Germany	2	25	–	–
	Total	853	8 101	747	5 734
2827.35	Nickel chlorides (weight of material, not nickel content)	–	–	–	–
2833.24	Nickel sulphates (weight of material, not nickel content)				
	United Kingdom	284	1 839	356	8 203
3815.11	Catalysts and other reaction initiators, reaction accelerators and catalytic preparations with nickel or nickel compounds as the substance (weight of material, not nickel content)				
	United States	138	62	1 514	607
	Belgium	19	100	–	–
	Total	157	162	1 514	607
7202.60	Ferronickel	–	–	–	–
7204.21	Stainless steel waste and scrap (weight of material, not nickel content)				
	United States	27 398	24 107	55 964	53 067
	China	1 372	1 400	4 870	3 626
	Taiwan	294	141	942	900
	India	858	827	523	635
	Japan	392	404	202	314
	Germany	–	–	51	130
	Netherlands	–	–	314	77
	South Korea	159	153	40	56
	Hungary	–	–	14	12
	Sweden	–	–	20	11
	Hong Kong	25	31	–	–
	United Kingdom	39	229	–	–
	Total	30 537	27 292	62 940	58 828
7501.10	Nickel mattes (nickel content)				
	Norway	48 381	663 611	49 781	571 056
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy (weight of material, not nickel content)				
	United Kingdom	38 061	284 775	37 492	382 630
	South Korea	2 649	17 325	8 761	85 511
	Taiwan	1 292	8 447	2 145	24 001
	United States	1 621	15 556	1 547	12 323
	Belgium	500	3 757	689	8 172
	Total	44 123	329 860	50 634	512 637

TABLE 1a (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7502.10	Nickel unwrought, not alloyed				
	United States	50 740	528 980	48 193	507 010
	Belgium	10 482	99 989	8 711	91 318
	Hong Kong	8 410	89 666	8 168	88 010
	Netherlands	7 954	72 285	5 627	59 850
	Taiwan	5 806	57 032	4 882	54 922
	United Kingdom	3 909	36 581	3 877	41 604
	Italy	5 038	49 049	2 836	30 866
	Japan	2 158	21 057	2 827	29 491
	Singapore	3 816	33 125	2 646	28 081
	China	1 614	14 714	1 836	20 599
	South Korea	844	7 552	1 750	18 848
	Spain	120	998	1 628	17 608
	Thailand	1 231	11 183	797	8 775
	India	–	–	558	6 380
	Australia	750	7 661	401	3 999
	France	1 104	9 928	291	3 157
	Luxembourg	24	195	240	2 480
	Philippines	72	800	98	1 133
	Indonesia	150	1 649	99	1 099
	Sweden	–	–	98	1 022
	Switzerland	145	1 412	36	387
	Vietnam	–	–	30	310
	Venezuela	10	126	10	117
	Germany	. . .	25	5	51
	Chile	72	830	–	–
	Turkey	36	409	–	–
	Brazil	23	240	–	–
	Total	104 508	1 045 486	95 642	1 017 117
7502.20	Nickel unwrought, alloyed (weight of material, not nickel content)				
	China	747	7 834	2 918	33 928
	Hong Kong	3 692	38 075	1 867	19 751
	South Korea	807	8 561	1 040	11 664
	India	–	–	201	2 139
	Belgium	1 332	13 163	92	778
	United States	39	460	54	452
	Italy	–	–	26	393
	United Kingdom	4	28	–	–
	Total	6 621	68 121	6 198	69 105
7503.00	Nickel waste and scrap (weight of material, not nickel content)				
	United States	2 573	10 783	1 888	5 919
	Netherlands	120	130	103	234
	Japan	19	62	20	204
	United Kingdom	69	277	19	134
	India	–	–	53	108
	Italy	–	–	4	100
	Germany	. . .	2	–	–
	Total	2 781	11 254	2 087	6 699
7504.00	Nickel powders and flakes, alloyed and unalloyed (weight of material, not nickel content)				
	United States	4 516	75 130	4 416	70 633
	Japan	786	9 803	2 186	25 172
	South Korea	148	1 509	357	3 902
	Luxembourg	264	2 326	273	2 892
	United Kingdom	23	3 214	25	2 436
	Taiwan	126	1 238	207	2 118
	Belgium	18	252	234	2 025
	Netherlands	60	551	149	1 640
	Germany	46	810	107	1 325
	Australia	–	–	102	986
	China	20	161	42	448
	France	12	138	9	206
	Brazil	3	58	9	134
	Ireland	1	19	8	133
	Thailand	7	149	4	68
	Chile	–	–	3	54
	Sweden	42	467	7	54
	Philippines	–	–	4	49

TABLE 1a (cont'd)

Item No.		2001		2002	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
	Argentina	...	3	3	45
	Indonesia	4	43	2	34
	Hong Kong	...	34	...	24
	New Zealand	–	–	...	20
	South Africa	2	64	1	10
	Ecuador	–	–	...	5
	Mexico	11	73	...	5
	Switzerland	2	26	–	–
	Czech Republic	1	11	–	–
	Turkey	2	26	–	–
	Austria	10	101	–	–
	India	...	9	–	–
	Total	6 104	96 215	6 148	114 418
7505.11	Bars, rods and profiles of nickel, not alloyed (nickel content)				
	United States	11	181	–	–
7505.12	Bars, rods and profiles of nickel alloy (weight of material, not nickel content)				
	United States	1	44	3	106
	France	–	–	...	6
	China	...	1	–	–
	Poland	1	6	–	–
	Brazil	17	105	–	–
	Total	19	156	3	112
7505.21	Nickel wire, not alloyed (weight of nickel wire plus coating if any, not nickel content)				
	United States	6	207	–	–
7505.22	Wire, nickel alloy (weight of alloy plus coating if any, not nickel content)				
	United States	22	493	5	168
	France	–	–	...	7
	Sweden	19	137	–	–
	Total	41	630	5	175
7506.00 (a)	Nickel plates, sheets, strip and foil (weight of material, not nickel content)				
	United States	16	676	...	621
	Sweden	–	–	20	185
	Poland	12	147	3	46
	Romania	–	–	1	10
	Libyan Arab Jamahiriya	–	–	1	4
	China	1	15	–	–
	South Korea	...	3	–	–
	Total	29	841	25	866
7507.00 (b)	Tubes, pipes and tube or pipe fittings alloyed and unalloyed (weight of material, not nickel content)				
	United States	..	2 864	..	1 779
	Venezuela	–	–	..	512
	Germany	..	7	..	331
	South Korea	–	–	..	75
	Singapore	..	91	..	69
	Algeria	–	–	..	56
	India	–	–	..	28
	United Arab Emirates	..	344	..	16
	France	–	–	..	11
	Australia	..	18	..	4
	Japan	..	267	–	–
	Brazil	..	647	–	–
	Malaysia	..	43	–	–
	New Zealand	..	3	–	–
	Total	..	4 284	..	2 881
7508.00	Other articles of nickel (weight of material, not nickel content)				
	United States	..	11 933	..	14 026
	Germany	..	104	..	312
	France	..	62	..	194
	Sweden	..	6	..	174

TABLE 1a (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
	Cuba	. .	7	. .	139
	China	. .	147	. .	134
	Dominican Republic	–	–	. .	100
	Poland	. .	179	. .	77
	Saudi Arabia	–	–	. .	56
	Norway	–	–	. .	56
	Australia	. .	22	. .	33
	United Kingdom	. .	152	. .	33
	Italy	. .	38	. .	15
	South Africa	–	–	. .	8
	Netherlands	. .	5	. .	8
	Singapore	. .	32	. .	8
	Spain	–	–	. .	7
	Hong Kong	. .	14	. .	3
	Switzerland	. .	2	. .	2
	French Polynesia	–	–	. .	2
	South Korea	. .	9	–	–
	New Zealand	. .	60	–	–
	Total	. .	12 772	. .	15 387
	Total exports	. .	2 271 051	. .	2 383 829
IMPORTS					
2604.00.00.20	Nickel ores and concentrates (nickel content)				
	Australia (1)	1 003	9 216	73 365	109 487
	Germany	–	–	6 179	12 177
	United States	938	5 929	10 774	6 281
	France	–	–	19	56
	Ivory Coast	–	–	2	15
	Total	1 941	15 145	90 339	128 016
	(NOTE: Trade data for 2604.00.00.20 imports for 2001 and 2002 are believed to be incorrect. Reader should refer to footnote (1) of Table 1a and to page 3 of the text.)				
2620.90	Ash and residues (material believed to contain nickel and cobalt)				
	Cuba (2)	–	303 997	–	333 314
2825.40	Nickel oxides and hydroxides (weight of material, not nickel content)				
	Finland	498	7 036	177	2 046
	United States	3 126	1 254	1 713	899
	Belgium	–	–	1	7
	Total	3 624	8 290	1 891	2 952
2827.35	Nickel chlorides (weight of material, not nickel content)				
	France	63	350	102	680
	United States	77	502	70	441
	Germany	–	–	. . .	2
	China	–	–	. . .	1
	Total	140	852	172	1 124
2833.24	Nickel sulphates (weight of material, not nickel content)				
	United States	1 610	5 228	2 381	5 284
	Finland	204	555	303	787
	Belgium	102	294	172	579
	Austria	6	18	20	60
	Germany	–	–	20	58
	Australia	2	6	–	–
	France	3	9	–	–
	South Africa	. . .	1	–	–
	Total	1 927	6 111	2 896	6 768

TABLE 1a (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
3815.11	Catalysts and other reaction initiators, reaction accelerators and catalytic preparations with nickel or nickel compounds as the substance (weight of material, not nickel content)				
	Luxembourg	–	–	136	6 073
	United States	489	5 519	337	4 458
	Germany	237	2 799	176	2 068
	Denmark	61	1 878	61	1 801
	United Kingdom	191	2 562	61	947
	South Africa	–	–	30	667
	India	14	116	38	371
	Netherlands	6	90	1	24
	Japan	–	–	1	18
	Belgium	8	186	2	15
	France	. . .	7	. . .	1
	Total	1 006	13 157	843	16 443
7202.60	Ferronickel (weight of material, not nickel content)				
	United States	65	339	14	74
	France	–	–	1	3
	Total	65	339	15	77
7204.21	Stainless steel scrap (weight of material, not nickel content)				
	United States	35 720	29 407	34 450	32 596
	China	238	259	291	312
	Canada	1	1	54	46
	Zimbabwe	–	–	19	13
	United Kingdom	–	–	1	. . .
	Total	35 959	29 667	34 815	32 967
7501.00 (c)	Nickel mattes (nickel content), nickel oxide sinters and other intermediate products of nickel metallurgy (weight of material, not nickel content)				
	Australia	4 634	26 187	513	2 537
	Belgium	353	453	–	–
	Chile	32	79	–	–
	Germany	982	1 041	–	–
	Japan	1	7	–	–
	New Caledonia	. . .	. . .	–	–
	Russia	34	40	–	–
	South Africa	1 564	5 997	375	2 206
	Taiwan	. . .	1	–	–
	United Kingdom	2	16	–	–
	United States	2 297	6 112	842	2 673
	Total	9 899	39 933	1 730	7 416
7502.10	Nickel unwrought, not alloyed (nickel content)				
	Norway	1 029	9 846	934	9 601
	Finland	171	1 913	261	2 442
	United States	56	657	195	1 955
	United Kingdom	45	266	94	1 131
	Canada	22	220	41	487
	Russia	65	612	39	430
	Nauru	–	–	37	408
	Zimbabwe	1	5	3	29
	France	11	123	1	13
	South Africa	4	32	1	5
	China	25	271	–	–
	Germany	. . .	4	–	–
	Total	1 429	13 949	1 606	16 501
7502.20	Nickel unwrought, alloyed (weight of material, not nickel content)				
	Russia	900	5 235	665	3 915
	United States	171	1 701	251	2 171
	United Kingdom	25	340	12	248
	Netherlands	–	–	20	92
	Germany	331	1 375	4	52
	France	–	–	. . .	3
	South Korea	–	–	. . .	3

TABLE 1a (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
	Belgium	. . .	5	. . .	2
	Norway	–	–	. . .	1
	Italy	. . .	. . .	. . .	1
	Austria	–	–	. . .	1
	Malaysia	104	198	–	–
	Total	1 531	8 860	952	6 489
7503.00	Nickel waste and scrap (weight of material, not nickel content)				
	United States	21 246	46 487	20 982	48 327
	United Kingdom	626	4 605	307	2 119
	Norway	38	374	70	457
	France	–	–	57	345
	Netherlands	–	–	37	166
	Latvia	–	–	41	137
	Germany	110	224	30	104
	Switzerland	–	–	21	76
	Japan	–	–	7	53
	Canada	25	70	3	6
	Argentina	14	60	–	–
	Russia	89	502	–	–
	South Africa	60	495	–	–
	Total	22 208	52 817	21 555	51 790
7504.00	Nickel powders and flakes, alloyed and unalloyed (weight of material, not nickel content)				
	Australia	1 323	12 831	673	6 478
	United States	261	4 203	360	4 350
	Germany	227	2 787	211	2 853
	United Kingdom	20	291	69	774
	Ireland	18	394	37	770
	Russia	11	125	27	366
	Belgium	104	1 222	4	61
	South Africa	–	–	3	43
	Finland	–	–	2	37
	Canada	2	57	2	30
	Sweden	. . .	12	. . .	14
	Israel	–	–	1	10
	Japan	3	75	1	7
	Austria	1	9	. . .	6
	Italy	. . .	1	. . .	5
	South Korea	7	75	. . .	1
	Switzerland	8	184	–	–
	Denmark	1	6	–	–
	Total	1 986	22 272	1 390	15 805
7505.11	Bars, rods and profiles of nickel, not alloyed (nickel content)				
	United States	11	194	15	294
	Germany	. . .	8	. . .	9
	United Kingdom	. . .	1	–	–
	Canada	. . .	1	–	–
	Total	11	204	15	303
7505.12	Bars, rods and profiles of nickel alloy (weight of material, not nickel content)				
	United States	937	19 987	629	14 557
	Germany	22	402	52	886
	Italy	17	377	16	442
	France	. . .	9	12	172
	United Kingdom	6	110	6	130
	Sweden	–	–	4	76
	Japan	7	157	2	63
	Canada	3	46	1	29
	Taiwan	. . .	1	. . .	6
	Spain	–	–	. . .	6
	Brazil	–	–	. . .	5
	China	–	–	. . .	2
	Mexico	–	–	. . .	1
	Romania	–	–	. . .	1
	Russia	–	–	. . .	1

TABLE 1a (cont'd)

Item No.		2001		2002(p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
	Argentina	1	6	–	–
	Austria	. . .	1	–	–
	Netherlands	. . .	6	–	–
	Cayman Islands	1	29	–	–
	Total	994	21 131	722	16 377
7505.21	Nickel wire, not alloyed (weight of nickel wire plus coating if any, not nickel content)				
	United States	41	483	43	521
	Japan	11	93	12	133
	Germany	10	178	1	10
	Sweden	4	48	. . .	1
	Switzerland	. . .	5	–	–
	Canada	. . .	3	–	–
	China	. . .	4	–	–
	Total	66	814	56	665
7505.22	Wire, nickel alloy (weight of alloy plus coating if any, not nickel content)				
	United States	314	6 709	285	5 455
	Sweden	32	623	87	1 609
	United Kingdom	70	525	88	1 345
	Germany	70	1 196	75	1 246
	France	36	495	39	562
	Australia	4	52	12	199
	Italy	3	50	9	179
	Austria	26	373	6	108
	Canada	–	–	1	4
	Japan	–	–	. . .	3
	China	–	–	. . .	1
	Mexico	. . .	4	. . .	1
	Taiwan	. . .	1	. . .	1
	New Zealand	–	–	. . .	1
	South Korea	4	26	–	–
	Belgium	15	211	–	–
	Swaziland	. . .	2	–	–
	Total	574	10 265	602	10 714
7506.00	Nickel plates, sheets, strip and foil (weight of material, not nickel content)				
	United States	440	10 552	591	12 621
	Germany	150	2 632	259	5 060
	Japan	8	160	18	380
	Netherlands	–	–	2	178
	Sweden	1	21	4	73
	United Kingdom	4	88	2	50
	Italy	. . .	14	4	33
	Spain	–	–	1	18
	France	1	42	1	15
	India	–	–	1	14
	Switzerland	–	–	. . .	9
	Bulgaria	–	–	. . .	4
	South Korea	–	–	. . .	2
	Poland	–	–	. . .	2
	Canada	. . .	1	–	–
	Finland	. . .	3	–	–
	Belgium	. . .	7	–	–
	Israel	. . .	4	–	–
	Total	604	13 524	883	18 459
7507.00	Tubes, pipes and tube or pipe fittings alloyed and unalloyed (weight of material, not nickel content)				
	Japan	782	37 548	514	17 805
	United States	770	15 941	551	12 963
	Norway	121	1 123	444	5 440
	France	53	1 996	63	2 105
	Germany	57	1 349	91	1 188
	United Kingdom	56	1 119	31	1 133
	Sweden	3	55	15	242
	Italy	8	214	22	206
	Spain	1	22	3	67
	Canada	. . .	3	1	14

TABLE 1a (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
	Brazil	17	293	1	6
	India	–	–	1	4
	Argentina	–	–	. . .	3
	Indonesia	–	–	. . .	2
	South Korea	–	–	. . .	2
	Australia	–	–	. . .	1
	Austria	. . .	4	. . .	1
	Hong Kong	. . .	4	. . .	1
	Taiwan	1	11	. . .	1
	China	2	10	–	–
	Mexico	9	85	–	–
	Russia	38	300	–	–
	Total	1 918	60 077	1 737	41 184
7508.00	Other articles of nickel (weight of material, not nickel content)				
	United States	737	12 872	711	11 457
	China	65	404	77	742
	Switzerland	39	254	100	667
	Canada	32	311	34	589
	United Kingdom	37	703	31	573
	Taiwan	32	366	37	460
	France	353	1 372	33	458
	Germany	4	46	15	400
	Israel	9	196	3	92
	Italy	7	130	5	71
	India	2	41	4	66
	Thailand	. . .	2	10	59
	South Korea	2	14	3	47
	Netherlands	1	9	1	22
	Australia	1	10	1	17
	Indonesia	3	6	1	11
	Austria	1	3	1	8
	Hong Kong	2	21	2	7
	Poland	1	10	1	7
	Japan	4	23	1	6
	Czech Republic	–	–	. . .	6
	Malaysia	. . .	6	. . .	3
	Spain	–	–	. . .	2
	Sweden	–	–	. . .	2
	Greece	. . .	4	. . .	1
	South Africa	–	–	. . .	1
	Mexico	. . .	5	. . .	1
	Norway	2	19	–	–
	Total	1 334	16 925	1 071	15 775
	Total imports		638 330		723 139
	Total exports	. .	2 271 051	. .	2 383 829
	Net exports of nickel		1 632 721		1 660 690

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; (p) Preliminary.
(a) Included in the data are HS Codes 7506.10 and 7506.20. (b) Included in the data are HS Codes 7507.11, 7507.12 and 7507.20.
(c) Included in the data are HS Codes 7501.10 and 7501.20.
(1) While no imports from Australia were recorded in 2000, Jubilee Mines NL recorded at least two shipments of nickel in concentrates to Canada in 2000; an investigation into these shipments has not been completed. In 2001, data shown by Statistics Canada are suspect as reported Australian shipments of nickel in concentrates to Canada were 11 675 t. In addition, the United States has no domestic producers of nickel in concentrate, so country of origin is wrong or classification is in error. In 2002, the data reported seriously overestimate the amount of nickel in concentrates imported from Australia and may be the tonnage of concentrates imported. Australian data show exports of 15 612 t of nickel in concentrates to Canada for 2002. Germany and the United States do not produce nickel concentrates so reported imports may come from other countries or be misclassified. (2) Nickel and cobalt are in an artificial nickel-cobalt sulphide made at an acid leach plant in Cuba using nickel-cobalt oxides as feed. The values reflect both the nickel and the cobalt contents.
Note: Numbers may not add to totals due to rounding.

TABLE 1b. CANADA, NICKEL PRODUCTION AND USE, 1970, 1975, 1980 AND 1985-2002

	Production (1) (Mine Output)	Use (2)
	(tonnes)	
1970	277 490	10 699
1975	242 180	11 308
1980	184 802	9 676
1985	169 971	7 206
1986	163 640	8 865
1987	193 391	9 732
1988	216 589	9 250
1989	200 899	10 421
1990	196 225	8 410
1991	192 259	(a) 13 322
1992	186 384	15 528
1993	188 080	(a) 17 384
1994	149 886	20 746
1995	181 820	20 973
1996	192 649	24 504
1997	(r) 190 502	19 447
1998	(r) 208 301	19 787
1999	(r) 186 236	22 527
2000	190 793	24 976
2001	194 058	17 735
2002 (p)	187 791	18 955

Source: Natural Resources Canada.

(p) Preliminary; (r) Revised.

(a) Increase in number of companies being surveyed.

(1) Refined nickel and nickel in oxides and salts produced, plus recoverable nickel in matte and concentrates exported. Data for 1987-2002 are nickel contained in concentrates produced.

(2) Use of metallic nickel, all forms (refined metal, nickel in ferronickel oxides and salts, and other forms of nickel including nickel in purchased scrap) as reported by users on the Natural Resources Canada survey "Nickel Used."

Note: Metals are used in industrial and consumer applications; unlike fuel oil or agricultural commodities, metals are not "used up" or "consumed"; instead, they are recycled. Discussions taking place in international fora indicate that the term "consumption" should be changed to more appropriately reflect actual practice. For this reason, the word "use" has replaced "comsumption" in this chapter, where appropriate.

TABLE 1c. CUPRONICKEL, NICKEL-SILVER, STAINLESS STEELS, AND NICKEL-CADMIUM AND NICKEL-IRON BATTERIES, 2001 AND 2002

	2001		2002	
	(tonnes)	($000)	(tonnes)	($000)
STAINLESS STEEL SEMI-FABRICATED ITEMS (excludes scrap)				
Exports – Total For Each HS Class				
7204.29	104 207	20 582	117 663	28 377
7210.90	4 988	7 392	12 112	11 973
7220.20	3 871	12 694	5 739	19 349
7222.11	6 686	15 595	2 902	6 341
7222.19	238	1 032	285	1 328
7222.20	11 502	57 483	5 767	30 415
7222.30	1 568	6 844	3 706	18 310
Total exports	133 060	121 622	148 174	28 464
Imports – Total For Each HS Class				
7204.29	163 183	51 916	155 277	50 197
7210.90	5 080	11 408	9 238	21 181
7212.50.90.13	3 336	8 038	3 508	9 356
7222.11	2 475	10 082	2 229	9 264
7222.19	3 004	14 668	3 831	15 648
7222.20.10	158	925	94	577
7222.20.90	9 187	36 856	9 750	36 387
7222.30.00.11	203	1 341	58	274
7222.30.00.19	5	22	2	10
Total imports	186 631	135 256	183 987	142 894
Net exports of stainless steels	-53 571	-13 634	-35 813	-114 430
CUPRO-NICKEL AND NICKEL-SILVER SEMI-FABRICATED GOODS (nickel-silver is a copper-nickel-zinc alloy)				
Exports – Total For Each HS Class				
7403.23	95	330	–	–
7407.22	150	1 067	239	1 563
7408.22	22	341	65	747
7409.40	1 899	9 823	615	2 569
7411.22	4 805	37 911	5 602	44 905
Total exports	6 971	49 472	6 521	49 784
Imports – Total For Each HS Class				
7403.23.00.10 to 7403.23.00.40	84	300	49	189
7407.22.11 to 7407.22.29.10	89	426	147	689
7408.22.10 to 7408.22.90.30	344	935	262	787
7409.40.00.11 to 7409.40.00.40	108	522	112	578
7411.22.00.10 to 7411.22.00.30	416	2 726	403	2 833
Total imports	1 041	4 909	973	5 076
Net exports of cupro-nickel and nickel-silver	5 930	44 563	5 548	44 708
ELECTRIC ACCUMULATORS (nickel-cadmium and nickel-iron batteries)				
Exports – Total For Each HS Class				
8507.30 Ni-Cd batteries	. .	7 916	. .	3 463
8507.40 Ni-Fe batteries	. .	158	. .	67
Total exports	. .	8 074	. .	3 530
Imports – Total For Each HS Class				
8507.30 Ni-Cd batteries	. .	43 861	. .	44 896
8507.40 Ni-Fe batteries	. .	840	. .	1 360
Total imports	. .	44 701	. .	46 256
Net exports of Ni-Cd and Ni-Fe batteries	. .	-36 627	. .	-42 726

Source: Natural Resources Canada.
– Nil; . . Not available.

TABLE 2a. CANADA, COBALT PRODUCTION AND TRADE, 2001 AND 2002, AND USE, 2000-02

Item No.		2001		2002 (p)	
		(kilograms)	($000)	(kilograms)	($000)
MINE OUTPUT	Cobalt content of concentrates produced	5 325 593		5 092 795	
SHIPMENTS	Recoverable content of cobalt in concentrates				
	Quebec	321 152	12 313	315 636	7 634
	Ontario	1 401 627	53 737	1 373 674	33 224
	Manitoba	389 636	14 938	338 153	8 179
	Total	2 112 415	80 988	2 027 463	49 036
	Refined (1)	4 062 613		4 303 055	
EXPORTS					
2605.00	Cobalt ores and concentrates (cobalt content)	–	–	–	–
2822.00	Cobalt oxides and hydroxides; commercial cobalt oxides (weight of material, not cobalt content)				
	United Kingdom	355 512	10 305	287 374	7 232
2915.23	Cobalt acetates (weight of material, not cobalt content)	–	–	–	–
8105.10	Cobalt, mattes and other intermediate products of cobalt metallurgy; unwrought cobalt; waste, scrap and powders (cobalt content of unwrought and mattes, and powders; weight of material for intermediates, alloys and waste and scrap)				
	Argentina	500	14	–	–
	Australia	73 000	2 275	–	–
	Belgium	410 038	20 104	–	–
	China	20 000	643	–	–
	France	–	–	–	–
	Hong Kong	85 174	2 219	–	–
	India	857	47	–	–
	Indonesia	–	–	–	–
	Japan	1 003 191	31 922	–	–
	South Korea	21 950	1 137	–	–
	Mexico	–	–	–	–
	Netherlands	584 800	20 510	–	–
	Norway	1 546 190	51 805	–	–
	Singapore	302 400	8 973	–	–
	United Kingdom	95 562	3 880	–	–
	United States	830 747	34 220	–	–
	Germany	1 724	185	–	–
	Portugal	500	22	–	–
	Switzerland	32	2	–	–
	Taiwan	250	12	–	–
	Total	4 976 915	177 970	–	–
8105.20	Cobalt mattes and other intermediate products; powders				
	Japan	–	–	1 704 195	41 804
	Norway	–	–	1 584 011	35 355
	United States	–	–	889 704	25 061
	Netherlands	–	–	620 200	14 723
	Singapore	–	–	533 550	12 644
	Belgium	–	–	382 771	11 943
	Taiwan	–	–	190 470	4 725
	Hong Kong	–	–	150 000	3 464
	United Kingdom	–	–	80 000	2 038
	China	–	–	19 173	994
	South Korea	–	–	20 949	855
	Indonesia	–	–	5 000	118
	Argentina			2 000	49
	Total			6 182 023	153 773
8105.30	Cobalt waste and scrap				
	United States	–	–	41 800	311

TABLE 2a (cont'd)

Item No.		2001		2002 (p)	
		(kilograms)	($000)	(kilograms)	($000)
EXPORTS (cont'd)					
8105.90	Cobalt and articles thereof, n.e.s.				
	United States	17 671	4 454	19 922	5 355
	Germany	11 184	3 092	8 584	1 536
	Switzerland	–	–	2 952	143
	Japan	–	–	10 041	120
	Brazil	106	21	264	51
	Ireland	–	–	734	47
	Sweden	396	87	138	41
	United Kingdom	1 116	227	138	32
	Mexico	188	56	94	26
	Panama	–	–	62	12
	South Korea	1	. . .	2	. . .
	Argentina	–	–	–	–
	Australia	–	–	–	–
	Austria	856	223	–	–
	France	–	–	–	–
	Netherlands	–	–	–	–
	China	73	19	–	–
	Dominican Republic	8	2	–	–
	Total	31 599	8 181	42 931	7 363
	Total exports	5 008 514	196 456	6 266 754	14 595
IMPORTS (2)					
2805.00	Cobalt ores and concentrates (cobalt content)				
	United States	18 724	626	18 892	309
	Finland	39 453	1 316	12 788	306
	Germany	60 541	589	8 915	90
	Belgium	2 970	115	–	–
	Poland	–	–	–	–
	Switzerland	–	–	–	–
	Total	121 688	2 646	40 595	705
2822.00.00.10	Cobalt hydroxides (weight of material, not cobalt content)				
	United States	31 367	1 270	5 697	336
	Finland	2 553	168	680	30
	United Kingdom	20	1	162	9
	Netherlands	–	–	–	–
	Belgium	32	2	–	–
	Total	33 972	1 441	6 539	375
2822.00.00.20	Cobalt oxides (weight of material, not cobalt content)				
	Japan	10 005	661	15 023	852
	United States	2 774	140	1 458	69
	Belgium	55 804	1 968	409	12
	Finland	75	5	45	3
	South Korea	–	–	–	–
	Australia	324	27	–	–
	Total	68 982	2 801	16 935	936
2822.00.00.30	Commercial cobalt oxides (weight of material, not cobalt content)				
	United Kingdom	492	9	491	9
	United States	364	8	304	6
	Italy	–	–	13	. . .
	Belgium	–	–	–	–
	South Korea	22 002	704	–	–
	Total	22 858	721	808	15
2827.34	Cobalt chlorides (weight of material, not cobalt content)				
	United States	45 409	703	20 605	318
	Japan	–	–	400	5
	United Kingdom	23	. . .	20	. . .
	Germany	50	1	8	. . .
	Total	45 482	704	21 033	323

TABLE 2a (cont'd)

Item No.		2001		2002 (p)	
		(kilograms)	($000)	(kilograms)	($000)
IMPORTS (cont'd)					
2833.29.00.40	Cobalt sulphate (weight of material, not cobalt content)				
	United States	24 371	399	41 443	609
	Philippines	1 814	25	12 426	164
	Finland	5 946	67	13 490	129
	China	–	–	500	4
	Russia	100	1	25	. . .
	Germany	–	–	3	. . .
	France	1 000	5	–	–
	United Kingdom	–	–	–	–
	Brazil	1 816	25	–	–
	Total	35 047	522	67 887	906
2836.99.10.30	Cobalt carbonates (weight of material, not cobalt content)				
	Philippines	. .	28	. .	170
	United States	. .	89	. .	46
	Belgium	. .	37	–	–
	Finland	. .	9	–	–
	Brazil	. .	33	–	–
	Total	. .	196	. .	216
2836.99.90.20	Other cobalt carbonates (weight of material, not cobalt content)				
	United States	12 473	324	5 528	124
	Finland	16 783	367	5 196	106
	China	–	–	500	9
	New Caledonia	–	–	1	. . .
	Total	29 256	691	11 225	239
2915.23	Cobalt acetates (weight of material, not cobalt content)				
	United States	26 645	301	13 516	153
	Canada	–	–	–	–
	United Kingdom	–	–	–	–
	Japan	13	. . .	–	–
	Total	26 658	301	13 516	153
8105.10.10.10	Cobalt waste and scrap fit only for remelting and recovery of the metal content (weight of material, not cobalt content)				
	Canada	–	–	–	–
	Germany	481 787	471	–	–
	Trinidad and Tobago	87	5	–	–
	United States	24 610	570	–	–
	Congo	199 616	1 109	–	–
	Japan	30 329	71	–	–
	Netherlands	37 106	151	–	–
	United Kingdom	105	5	–	–
	Total	773 640	2 382	–	–
8105.10.10.20	Cobalt powders (cobalt content)				
	Australia	367 580	9 224	–	–
	Belgium	90 202	2 935	–	–
	France	1 469	151	–	–
	Germany	422	32	–	–
	Hong Kong	–	–	–	–
	Japan	5 010	57	–	–
	Netherlands	–	–	–	–
	South Africa	55 502	1 963	–	–
	Sweden	136	7	–	–
	United Kingdom	5 709	324	–	–
	United States	77 744	3 355	–	–
	Finland	59 403	2 144	–	–
	Ireland	6 000	205	–	–
	Russia	82	6	–	–
	Switzerland	13 008	383	–	–
	Total	682 267	20 786	–	–

TABLE 2a (cont'd)

Item No.		2001		2002 (p)	
		(kilograms)	($000)	(kilograms)	($000)
IMPORTS (cont'd)					
8105.10.10.30	Unwrought cobalt, not alloyed (cobalt content)				
	Bahamas	–	–	–	–
	Congo	27 907	881	–	–
	Japan	–	–	–	–
	Russia	–	–	–	–
	Switzerland	–	–	–	–
	United States	1 502	81	–	–
	Belgium	15	1	–	–
	Ireland	83	3	–	–
	Zambia	4 000	122	–	–
	Total	33 507	1 087	–	–
8105.10.90	Unwrought cobalt, alloyed, mattes and other intermediate products of cobalt metallurgy (cobalt content of unwrought and mattes; weight of material for intermediates and alloys)				
	Switzerland	–	–	–	–
	United States	14 706	473	–	–
	Japan	284	4	–	–
	Total	14 990	477	–	–
8105.20.10.10	Cobalt powders				
	Australia	–	–	441 328	8 023
	United States	–	–	50 289	2 403
	Germany	–	–	13 382	364
	United Kingdom	–	–	7 556	341
	Finland	–	–	11 700	282
	South Africa	–	–	6 000	163
	France	–	–	1 717	136
	Belgium	–	–	1 309	70
	Canada	–	–	792	17
	China	–	–	250	7
	Sweden	–	–	140	3
	Norway	–	–	15	. . .
	Total	–	–	534 478	11 809
8105.20.10.20	Unwrought cobalt, not alloyed				
	Congo	–	–	20 107	457
	United States	–	–	7 874	380
	South Africa	–	–	10 538	247
	Brazil	–	–	6 000	124
	Russia	–	–	4 094	106
	Belgium	–	–	1 136	29
	Norway	–	–	250	7
	Germany	–	–	73	5
	France	–	–	40	3
	United Kingdom	–	–	9	1
	Japan	–	–	1	. . .
	Total	–	–	50 122	1 359
8105.20.90	Other				
	United States	–	–	2 797	125
8105.30	Cobalt waste and scrap				
	United States	–	–	190 784	784
	Germany	–	–	590 595	663
	Japan	–	–	15 017	19
	Zimbabwe	–	–	123	6
	Hong Kong	–	–	400	2
	Total	–	–	796 919	1 474
8105.90.00.10	Cobalt bars and rods, not alloyed (cobalt content)				
	United States	4 550	422	8 363	654
	Canada	97	6	152	10
	Japan	55	3	49	3
	United Kingdom	–	–	–	–
	Switzerland	26	2	–	–
	Total	4 728	433	8 564	667

TABLE 2a (cont'd)

Item No.		2001		2002 (p)	
		(kilograms)	($000)	(kilograms)	($000)
IMPORTS (cont'd)					
8105.90.00.90	Cobalt and articles thereof, n.e.s. (cobalt content)				
	United States	51 051	6 558	33 766	4 064
	Norway	–	–	20 167	1 061
	United Kingdom	459	25	619	34
	Canada	999	75	445	29
	Japan	10	1	558	18
	Germany	1	. . .	111	12
	France	–	–	138	8
	Belgium	997	69	29	2
	South Africa	–	–	1	. . .
	China	8	1	–	–
	Mexico	–	–	–	–
	Switzerland	–	–	–	–
	Total	53 525	6 729	55 834	5 228
	Total imports		41 917		24 530
	Total exports		196 456		14 595
	Net exports		154 539		-9 935

USE (3)	**2000**	**2001**	**2002**
		(kilograms)	
Cobalt contained in:			
Cobalt metal and metallic compounds	46 698	x	54 532
Cobalt pigments, feed and ground coat frit	8 487	x	x
Cobalt salts and driers and other uses (4)	71 530	52 657	x
Total	126 715	94 270	91 962

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expresssed; (p) Preliminary; x Confidential. .
(1) This total includes cobalt refined production sourced from both domestic and imported feed materials, including mixed nickel-cobalt sulphides from Cuba.
(2) Nickel-cobalt sulphides as reported by the International Nickel Study Group (imported into Canada under classification HS 2620.90 Ash and Residue). This material shown in Table 1a includes both the weight and value of imported nickel and cobalt from Cuba and is not included in this table. (3) Available data as reported by users. (4) Other uses include glass and chemicals.
Notes: Numbers may not add to totals due to rounding. The absence of a tonnage and value for the cobalt being imported from Cuba (total value shown in nickel Table 1a, entry 2620.90) in the mixed nickel-cobalt sulphides from Cuba means that the total imports shown are less than the actual imports.

TABLE 2b. CANADA, COBALT PRODUCTION, TRADE AND USE, 1975 AND 1980-2002

	Concentrate Shipments (1)	Processed Cobalt Exports (2)	Cobalt Oxide and Hydroxide Exports	Cobalt Ore and Concentrate Exports (3)	Cobalt Oxide and Hydroxide Imports (4)	Use (5)
			(tonnes)			
1975	1 354	431	561	. .	. .	123
1980	2 118	325	1 091	2	26	105
1981	2 080	677	601	24	20	101
1982	1 274	585	212	2	30	81
1983	1 410	885	192	45	30	101
1984	2 123	1 487	373	14	27	113
1985	2 067	1 551	268	36	192	101
1986	2 297	1 805	374	20	31	96
1987	2 490	1 875	440	45	38	120
1988	2 398	3 062	953	98	37	159
1989	2 344	3 262	371	22	33	147
1990	2 184	3 039	391	–	73	194
1991	2 171	3 456	459	–	42	166
1992	2 223	2 963	489	–	64	205
1993	2 150	3 581	394	–	52	187
1994	1 846	3 922	204	–	81	193
1995	2 016	4 227	–	–	41	148
1996	2 150	(r) 4 488	632	–	33	147
1997	2 168	5 829	526	–	39	136
1998	2 262	6 592	457	–	45	146
1999	2 014	6 307	224	10	114	130
2000	2 022	4 987	335	–	103	127
2001	2 112	5 008	355	–	126	94
2002 (p)	2 027	6 225	287	–	24	92

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; (p) Preliminary; (r) Revised.
(1) Production includes recoverable cobalt in concentrates shipped. Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. (2) Processed cobalt includes all forms classified in HS code 8105.10 (intermediate forms such as cobalt in matte, unwrought cobalt, alloyed cobalt, waste or scrap of cobalt, cobalt powders) plus all forms classified in HS code 8105.90 (cobalt and articles thereof, not elsewhere specified). (3) Cobalt content. From 1975 to 1988, cobalt recovered in Canada from domestic concentrate plus exports of payable cobalt in concentrate. Starting in 1989 to date, recoverable cobalt in concentrates shipped. (4) Gross weight. Producers' domestic shipments of refined cobalt plus imports of refined shapes. (5) Use of cobalt in metal, oxides and salts; available data as reported by user.

TABLE 3. CANADIAN NICKEL PRODUCERS - SOURCES FOR MORE CORPORATE INFORMATION ON THE INTERNET

Full Corporate Name	Web Site	SEDAR Site
Canmine Resources Corporation	not available	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00012293&lang=EN
Falconbridge Limited	www.falconbridge.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00000376&lang=EN
Inco Limited	www.inco.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001084&lang=EN
Voisey's Bay Nickel Corporation	www.vbnc.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001084&lang=EN
North American Palladium Ltd.	www.napalladium.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00003026&lang=EN
Sherritt International Corporation	www.sherritt.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00002460&lang=EN
Dynatec Corporation	www.dynatec.ca	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00008191&lang=EN
FNX Mining Company Inc.	www.fnxmining.com	www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00008610&lang=EN

Source: Natural Resources Canada.

TABLE 4. CANADIAN NICKEL PRODUCERS

Company	Location	Operation	Production Data Nickel 2001	 Nickel 2002	 Cobalt 2001	 Cobalt 2002	Type of Ni Output	Remarks
			(t)					
Canmine Resources Corporation	Cobalt, Ont.	Hydrometallurgical refinery	–	minimal	–	minimal	Ch	Refinery commissioning started in Dec. 2001; scheduled to be completed in late Q1 2002; initial capacity of 300 t/y Co in chemicals plus by-product Ni in chemicals.
Falconbridge Limited	Katinniq, in Nunavik territory, Que.	Raglan mine/mill	24 570	24 636	318	386	S	Mill optimization completed, mill operated at capacity in Q4; forecast production for 2002 of 26 000 t Ni in concentrate (Jan. 2002 forecast); production in 2000 and 2001 affected by labour strike.
Falconbridge Limited (1)	Sudbury, Ont.	**Sudbury Operations**						
		Craig mine, u/g	17 300	17 300			SO	Ni in ore mined, rounded to nearest 100 t.
		Fraser mine, u/g	7 300	6 900			SO	Ni in ore mined, rounded to nearest 100 t.
		Lindsley mine, u/g	3 600	5 000			SO	Ni in ore mined, rounded to nearest 100 t.
		Lockerby, u/g	3 100	5 400			SO	Ni in ore mined, rounded to nearest 100 t.
		Total	31 300	34 600				
		Strathcona mill	25 226	27 833	680	690	S	10 000-t/d capacity; mill produces bulk concentrate for shipment by truck to company smelter at Falconbridge, Ont.
		Smelter	54 892	57 854	1 788	1 955	M	Processes concentrate from Falconbridge's Sudbury and Raglan operations plus recyclable Ni, Co, Cu; SO_2 is captured to make sulphuric acid; matte is exported to Falconbridge's Nikkelverk refinery in Norway; provincial permission to export up to 45 360 t/y of recoverable Ni in matte until end of 2009; new draft SO_2 regulations issued in September cutting emission limit by 33% by 2007 and ground level concentration to 0.34 ppm by April 2002.
Inco Limited	Sudbury, Ont.	**Sudbury Operations** (2)						
		Copper Cliff North mine, u/g					SO	Nominal ore production rate = 900 000 t/y; capacity = 2800 t/d.
		Copper Cliff South mine, u/g					SO	Nominal ore production rate = 1 000 000 t/y; capacity = 3000 t/d.
		Creighton mine, u/g					SO	Nominal ore production rate = 1 100 000 t/y; capacity = 4000 t/d; ground stability problems affecting ore pass reduced production in 2002.
		Garson mine, u/g					SO	Nominal ore production rate = 700 000 t/y; capacity = 2000 t/d; Dynatec Corporation won $27 million contract to sink 1000-m ventilation shaft and complete associated underground development work.
		Lower Coleman mine, u/g					SO	Mine closed in 2001 except for lower portion; previous capacity was 1400 t/d of ore.
		McCreedy East mine, u/g					SO	Nominal ore production rate = 1 200 000 t/y including Lower Coleman production; capacity of McCreedy East = 2800 t/d of ore.

	Stobie mine, u/g					SO	Includes remaining operations at Frood mine; nominal ore production rate = 3 500 000 t/y, capacity = 8300 t/d of ore.
	Clarabelle mill					S	36 000-t/d mill takes output of all Inco's Sudbury area mines; improved recovery of Ni by 3.4% since 1999; head grade of 1.46% Ni and 1.54% Cu in 2002.
	Nickel smelter					M	Twin flash smelters; slow cooling of matte, then milling to separate to Ni and Cu streams; matte is sent to matte plant, refinery in Sudbury basin, or refinery in United Kingdom; capacity 100 000 t/y of Ni in matte.
	Matte processing plant					II	Produces Ni oxide sinter for export to refineries in Korea and Taiwan or for use in stainless steel industry.
	Nickel refinery					I	59 000-t/y carbonyl refinery producing high-purity Ni pellets, powders and foams.
	Finished Ni production from Sudbury facilities	61 200	68 700			I, II	Inco reported production from Ontario plus Clydach operations less INSG reported production from the United Kingdom for 2001 and 2002.
Clydach, United Kingdom	Nickel refinery	33 800	33 800			I	Carbonyl refinery producing high-purity Ni pellets, powders and foams from Sudbury feed; returns residue to Canada for reprocessing; Co oxide produced from feed exported from Thompson, about 20% of Inco's Co production in 2001 was in the form of Co oxide; Ontario government permission to export Ni sulphide matte, Ni sulphate residues, Ni oxide sinter, and PGM concentrates until year-end 2005.
	Finished Ni production from Sudbury and Clydach	95 000	102 500			I	As reported by Inco in briefing to investment community, February 2003.
	Cobalt originating from Sudbury ores			(e) 885	(e) 930	S	63% of Inco's Co production is sourced from Inco's Ontario ores; Cobalt Development Institute reported that Inco produced 1480 of Co in 2002, implying Ontario provided 930 t of cobalt product in 2002.
Port Colborne, Ont.	Co refinery			(e) 1 200	(e) 1 200	I	Produces refined Co from Ni-Co carbonate feed from Sudbury; Au, Ag and PGMs separated for further treatment at other sites; PGMs are sent to Inco's Acton, U.K., plant for final recovery; capacity of 1360 t/y of refined Co; about 80% of Inco's Co production is metal assumed to be entirely produced at Port Colborne; Inco Co deliveries were 1582 t in 2002 but produced 1480 t of Co in 2002 according to the Cobalt Development Institute. Court rejected certification of legal action as being a class action in suit brought in 2001; appeal expected to be heard in 2003.
Thompson, Man.	**Manitoba Operations**						1400 employees; all mines underground.
	Thompson mine, u/g					SO	Production 4500 t below target due in part to maturity of Thompson mine where grades are lower and stopes are smaller.
	Thompson mill					S	13 000 t/d mill; head grade in 2002 was 2.40% Ni; Cu concentrate sent to Sudbury for smelting.
	Thompson smelter					M	Electric furnace smelts partially roasted Ni concentrates from Thompson plus imported concentrates from Cosmos and Emily Ann mines in Australia. Inco's total "external" feed in 2002 added 17 000 t of finished nickel to Inco's output of which an estimated 5300 t came from Emily Ann and an estimated 9800 t came from Jubilee; the bulk of this material is believed to have been destined for the Thompson smelter. Smelter experienced problems due to high magnesium oxide level.

TABLE 4 (cont'd)

			Production Data					
Company	Location	Operation	Nickel 2001	Nickel 2002	Cobalt 2001	Cobalt 2002	Type of Ni Output	Remarks
			(t)					
		Thompson refinery					I	55 000-t/y electrolytic Ni refinery produces rondelles and cathodes, the majority of which is used for electroplating applications; Co hydrate is sent to Port Colborne for recovery; Co oxide is sent to the U.K. for processing.
		Finished Ni production from Manitoba	49 900	45 400				As reported by Inco, rounded to nearest 1000 t.
The Cobalt Refinery Company Inc.	Fort Saskatchewan, Alta.	Hydrometallurgical nickel and cobalt refinery	29 225	31 694	2 943	3 065	I	Sherritt International Corporation and General Nickel Company S.A. (owned by the Cuban Ministry of Basic Industries) together own a 50:50 joint venture called Metals Enterprise, which owns The Cobalt Refinery Company Inc.; refinery output progressively increased over past years by de-bottlenecking; produces by-product fertilizer. Record quarterly nickel production of 8282 t in Q2 and record quarterly cobalt production in Q4.
North American Palladium Ltd.	85 km from Thunder Bay, Ont.	Open-pit mine and mill	724	1 254			S	Open-pit palladium mine with by-product Ni production; expansion to 15 000 t/d from 2400 t/d in 2001. Equipment problems with new mill and crusher prevented operation from reaching full capacity. New crusher expected to be completed by mid-2003. Concentrates containing PGMs, nickel and copper are sent to Inco and Falconbridge Sudbury smelters.

Sources: Various annual reports, web sites, industry publications and press releases. Some specific sources are noted below:

Falconbridge Annual Report and Annual Information Form for 2001 and 2002;
Canadian Mining Journal, April-May 2002;
Refined Ni production of U.K. according to INSG - Clydach is the sole primary Ni refinery in the U.K.;
Inco Annual Report and 10K report for 2001 and 2002;
Mining and Mineral Processing Operations in Canada, 2000-2001, Natural Resources Canada;
Sherritt International Corporation Annual Report 2001, 2002;
North American Palladium Annual Report 2001, 2002.

Ch = Ni in chemicals.
I = Class I Ni (e.g., cathodes, briquettes, pellets, powders, etc., which have a Ni content of 99% ore more).
II = Class II Ni (e.g., products with a Ni content of less than 99% such as FeNi, NiO, UTILITY^{TM} Ni).
M = matte.
S = sulphide concentrates.
SO = sulphide ore mined.

(1) Falconbridge Limited's production in 2000 and 2001 was affected by a labour strike.

(2) Nominal production as reported in the *Canadian Mining Journal*, April/May 2002; capacity as reported in 2000-01 *Mining and Mineral Processing Operations in Canada*, MR 251, Natural Resources Canada; data are for different periods and may not agree. Data are not available for Inco's Gertrude mine.

TABLE 5. LIST OF WORLD NICKEL PRODUCERS, 2002

Country	Full Corporate Name or Identifier	Web Site
Albania	Bitincka mine	www.larco.gr
Australia	Anaconda Nickel Limited	http://www.minara.com.au/
	Goldfields Mine Management Pty Ltd.	(unknown)
	Jubilee Gold Mines NL	www.jubileemines.com
	LionOre Australia (Nickel) Ltd.	www.lionore.com
	Miitel JV	www.mincor.com.au
	OM Group, Inc. (OMG)	www.omgi.com
	Outokumpu Mining Australia Pty. Ltd.	www.outokumpu.com
	Preston Resources Limited	www.prestonres.com.au
	QNI Ltd.	www.qni.com.au; www.bhpbilliton.com
	Tectonic Resources NL	www.tectonicres.com.au
	Titan Resources NL	www.titanresources.com.au
	WMC Limited	www.wmc.com
Austria	Treibacher Industrie AG	www.treibacher.at/en/index.html
Botswana	BCL Limited	(unknown)
	Tati Nickel Mining Company (Proprietary) Limited	www.lionore.com
Brazil	Barro Alto Mineração Limitada project	www.angloamerican.co.uk
	Codemin SA	www.angloamerican.co.uk
	Companhia Níquel Tocantins	http://www.vmetais.com.br/english/index.htm
	Mineração Serra da Fortaleza Limitada	www.riotinto.com
Canada	Canmine Resources Corporation	(unknown)
	Falconbridge Limited	www.falconbridge.com
	Inco Limited	www.inco.com
	North American Palladium Ltd.	www.napalladium.com
	Sherritt International Corporation; The Cobalt Refinery Company Inc.; Metals Enterprise	www.sherritt.com
China	Jilin Nickel Co.	www.jinickel.com.cn/edefault.htm
	Jinchuan Nonferrous Metals Corporation	http://www.jnmc.com/default.asp
	Jinco Nonferrous Metals Co., Ltd.	www.inco.com; www.jnmc.com
	Sichuan Copper-Nickel Co.	(unknown)
	Simsen Metals (Holdings) Ltd.	(unknown)
	Tonghua Ni Cu mine (corporate name unknown)	(unknown)
	Huili Ni mine (corporate name unknown)	(unknown)
	Xinjiang Nonferrous Metals Industry Corporation	(unknown)
Colombia	Cerro Matoso S.A.	www.bhpbilliton.com
Cuba	Moa Nickel S.A.	www.sherritt.com
	Union del Niquel	(unknown)
Dominican Rep.	Falconbridge Dominicana, C. por A.	www.falconbridge.com
Finland	Kokkola Chemicals Oy	www.omgi.com
	Mondo Minerals	www.mondominerals.com/
	OM Group, Inc.	www.omgi.com
	OMG Harjavalta Nickel Oy	www.omgi.com
	Outokumpu Oyj	www.outokumpu.com
France	Eramet Group, The	www.eramet.fr
Former Yugoslav Republic of Macedonia	Feni-Rudnici i Industrija za Nikel, Celik i Antimon (FENI)	(unknown)
Greece	General Mining and Metallurgical Co. S.A.	www.larco.gr
Indonesia	PT Antam Tbk	www.antam.com
	PT International Nickel Indonesia Tbk	www.inco.com

TABLE 5 (cont'd)

Country	Full Corporate Name or Identifier	Web Site
Japan	Hyuga Smelting Co., Ltd.	www.smm.co.jp
	Inco TNC Limited	www.inco.com
	Nippon Yakin Kogyo Co., Ltd.	www.nyk.co.jp (mostly Japanese, annual reports at: http://www.nyk.co.jp/main/english/index.html)
	Pacific Metals Co., Ltd.	www.pacific-metals.co.jp (Japanese only)
	Sumitomo Metal Mining Co., Ltd.	www.smm.co.jp
Kazakhstan	Kempirsai Mining Directorate	(unknown)
Korea, Rep. of	Korea Nickel Corporation	www.inco.com
New Caledonia	Goro Nickel S.A.	www.inco.com
	Le Nickel-SLN	www.eramet.fr
	Société Minière du Sud Pacifique S.A., La	(unknown)
	Société Minière Georges Montagnat S.A.	(unknown)
	Société des Mines de la Tontouta	(unknown)
Norway	Falconbridge Nikkelverk Aktieselskap	www.falconbridge.com
	Nikkel og Olivin A/S	www.outokumpu.com
	Titania A/S	(unknown)
Philippines	Cagdianao Mining Corporation	(unknown)
	Hinatuan Mining Corporation	(unknown)
	Rio Tuba Mining Corporation	(unknown)
	Taganito Mining Corporation	(unknown)
Russia	MMC Norilsk Nickel	www.nornik.ru/index.jsp?lang=E
	Rezh Nickel Plant Joint Stock Company	(unknown)
	Ufaleynikel Joint Stock Co.	(unknown)
	Yuzhuralnikel Kombinat Joint Stock Co.	(unknown)
Serbia	Ferro-Nickel D.D. Glogovac	(unknown)
South Africa	Anglo American Platinum Corporation Limited	www.angloplatinum.com
	Impala Platinum Holdings Limited	www.implats.co.za
	Lonmin plc	www.lonmin.com
	Nkomati JV	www.avmin.co.za
Taiwan, China	Taiwan Nickel Refining Corporation	(unknown)
Ukraine	Nikomed Limited	(unknown)
United Kingdom	Inco Limited	www.inco.com
Venezuela	Minera Loma de Niquel C.A.	www.angloamerican.co.uk
Zimbabwe	Bindura Nickel Corporation Limited	www.angloamerican.co.uk
	Rio Tinto Zimbabwe Limited	www.riotinto.com
	Makwiro Platinum Mines (Private) Limited	www.zimplats.com

Source: Natural Resources Canada.

Note: Some operations may be idled.

TABLE 6. WORLD NICKEL PRODUCERS, 2002

<table>
<tr><th rowspan="2">Country</th><th rowspan="2">Company</th><th rowspan="2">Operation</th><th colspan="2">Nickel Output</th><th rowspan="2">Cobalt in 2002</th><th rowspan="2">Type of Ni output</th></tr>
<tr><th>2001</th><th>2002</th></tr>
<tr><td></td><td></td><td></td><td colspan="2">(t)</td><td></td><td></td></tr>
<tr><td>AUSTRALIA</td><td>Anaconda Nickel Limited</td><td>Murrin Murrin mine, PAL, refinery</td><td>24 991</td><td>30 010</td><td>1 838</td><td>I</td></tr>
<tr><td colspan="7">Remarks: Production remained below targets; higher-grade ore being mined to maximize production and grade decline termed a "stategic issue"; operation forecast to achieve operating rate of 32 000 to 36 000 t/y Ni only by mid-2004; Mt. Margaret development deferred despite interest by Jinchuan Nonferrous Metals Corporation; Anaconda defaulted on US$400 million bonds and creditors agreed to restructuring; Glencore to underwrite new share issue in 2003.</td></tr>
<tr><td></td><td>Goldfields Mine Management Pty Ltd.</td><td>Otter Juan and Cornet mines</td><td>(e) 2 300</td><td>?</td><td>?</td><td>SO</td></tr>
<tr><td colspan="7">Remarks: No data found for 2002.</td></tr>
<tr><td></td><td>Jubilee Mines NL</td><td>Cosmos mine, mill</td><td>11 000</td><td>11 300</td><td>?</td><td>S</td></tr>
<tr><td colspan="7">Remarks: Pit mining moving to final stages with first production from u/g mine expected by June 2003; tonnage and grade exceed original reserve calculation by 1% and 15%, respectively; total of 70 000 t of concentrate grading 19.5% Ni dispatched for Canada; smelting and refining costs averaged about A$1.46/payable pound during 2002; about 2.6 km decline developed during year plus raises and horizontal drifting. Jubilee reported quarterly smelting/refining charges of between A$1.43 and $1.48/lb in 2002 (equal to US77¢-80¢/lb based upon Bank of Canada exchange rates); Jubilee ships nickel concentrate to Inco Limited in Canada.</td></tr>
<tr><td></td><td>LionOre Australia (Nickel) Ltd.</td><td>Emily Ann mine, mill</td><td>110</td><td>5 745</td><td>?</td><td>S</td></tr>
<tr><td colspan="7">Remarks: Mine start-up completed in Q2; some concentrate smelted at WMC rather than being shipped to Inco, but majority of concentrate shipped to Inco's smelters in Canada; shipments of payable Ni in 2002 totaled 5301 t (about 91% of contained); LionOre Mining purchased minority shares in LionOre Australia (Nickel) after obtaining exclusive option from QNI Pty Ltd. (which operates the Yabulu refinery in Queensland and in turn is owned by BHP Billiton plc) to acquire QNI's 69% share in the Maggie Hayes high-grade deposit, located 2 km from the Emily Ann mine concentrator; total underground development of 2.4 km including main decline advance of 453 m; production rate of 320 000 t/y targeted during Q4 2003. Project completion attained in Q4 and escrow funds released.</td></tr>
<tr><td></td><td>Miitel JV</td><td>Miitel and Wannaway mines</td><td>8 062</td><td>13 500</td><td>260</td><td>SO</td></tr>
<tr><td colspan="7">Remarks: North Miitel orebody discovered, 253 000 t indicated + inferred resource @ 3.9% Ni; five detailed feasibility studies ongoing at year-end to mine Redross, Mariners and North Miitel plus two small orebodies; data for 2001 Ni production revised; Co data reflect payable Co, thus contained Co is higher.</td></tr>
<tr><td></td><td>OM Group, Inc. (OMG)</td><td>Cawse mine, PAL, refinery</td><td>?</td><td>(e) 9 000</td><td>(e) 900</td><td>T</td></tr>
<tr><td colspan="7">Remarks: Company does not reveal data of Ni-Co intermediate shipped to Finland for refining; however, in transcripts of 2002 Fourth Quarter conference call, a reference was made to Cawse output of about 9000 t of nickel. In OMG's 10K, reference was made to production of about 8000 t/y of Ni. Cobalt production is assumed to be 10% of nickel production. Cobalt from Cawse is eventually recovered at OMG's Kokkola facility.</td></tr>
<tr><td></td><td>MPI Nickel Pty Ltd. (formerly owned by Outokumpu Mining Australia Pty. Ltd.)</td><td>Black Swan mine, mill</td><td>21 800</td><td>14 350</td><td>?</td><td>S</td></tr>
<tr><td colspan="7">Remarks: Mine and mill sold to MPI Nickel (owned 80% by MPI Mines Ltd. and 20% by OM Group, Inc. (OMG) through OMG Kokkola Chemicals Holdings BV); forecast production in 2003 of 9740 t of Ni; Cygnet orebody expected to be mined out in 2002 with Gosling orebody to be mined out in 2003; concentrate sold to Harjavalta smelter in Finland on contract; contract expires in 2004.</td></tr>
</table>

TABLE 6 (cont'd)

Country	Company	Operation	Nickel Output		Cobalt in 2002	Type of Ni output
			2001	2002		
				(t)		
	Preston Resources Limited	Bulong mine, PAL, SX-EW	6 977	(e) 6 000	200	I
Remarks: Production in first half of 2002 was 3270 t Ni and 220 t Co; data not released for the year 2002 - estimate by author that 2002 production was in order of 6000 t of Ni. Agreement reached in late August whereby Preston Resources gave up 95% ownership in Bulong to Barclays Bank plc and other noteholders in return for Preston being released from financial obligations associated with Bulong. Operation sources sulphuric acid from WMC Resources Ltd.						
	QNI Ltd.	Yabulu refinery; ammonia leach	28 500	30 000	1 863	I
Remarks: Imported 2 Mt limonitic laterite ore in 2002 from SMSP in New Caledonia; studies of Ravensthorpe mine/leach plant development and expansion of Yabulu to 45 000 t/y Ni plus 1800 t/y Co to process the mixed Ni-co hydroxide not expected to be completed until late 2003; Queensland government to contribute A$10 million to training and infrastructure costs at Yabulu.						
	Sally Malay Mining Limited	mine/mill project	–	–	–	S
Remarks: Off-take agreement negotiated with Jinchuan Nonferrous Metals Corporation in July for life of mine production. Bankable feasiblity study completed in August showed 41 300 t of nickel and 2000 t of cobalt in concentrate to be produced over 5 1/2-year life. A$55 million project based upon proven plus probable reserves of 3 417 000 t @ 1.56% Ni, 0.64% Cu and 0.08% Co. First contracts were awarded in Sept; plans call for first production in Q1 2004.						
	Tectonic Resources NL	RAV 8 mine, mill	4 008	2 450	?	S
Remarks: Orebody life extended (had been expected to be mined out in July 2002); after proving up more ore, mining continued past year-end. Reserves at end of 2002 were 50 000 t, equal to about nine months of the average mining rate in 2002. Ore was trucked to Kambalda mill and sold to WMC Resources.						
	Titan Resources NL	Radio Hill mine, mill	4 755	3 387	211	S
Remarks: Radio Hilll mine reserves exhausted; property including disseminated material sold to Fox Resources Limited in September 2002; BioHeap™ test work continued on Jinchuan, Inco and WMC material; JV being negotiated with Jinchuan targetting 200 000 t trial in 2003 followed by 1 800 000-t trial in 2004/05. No details about Co recovery from property.						
	WMC Resources Limited**	Kambalda mines, mill	18 653	23 225	?	S
Remarks: Long/Victor mine sold to Independence Gold in Sept. for A$15 million with ore treatment to occur at WMC's Kambalda mill; independent operators of recently sold mines increased production in 2002 resulting in 25% increase in Ni in concentrate production in 2002 compared to 2001.						
	WMC Resouces Limited	Leinster mines, mill	38 008	40 006	?	S
Remarks: Mill recovery was upgraded in Sept. and WMC expects to increase recovery by 2.3%; Q1 announcement that drilling below 1100-m level confirmed continuity of main disseminated sulphide zone; Harmony pit scheduled to close in 2004.						

	WMC Resouces Limited	Mt. Keith pit, mill	47 930	43 192	?	S

Remarks: Upgraded nickel recovery in Sept., expect to increase recovery by 1.5%; concentrates exported to Harjavalta smelter in Finland; feasibility study to increase pit output by 25% to be finished in early 2003, which would raise mining rate from 11 Mt/y to 14 Mt/y for A$200 million and a subsequent increase to 16 Mt/y; commissioning could begin after mid-2004; expansion does not depend upon mining of Yakabindie deposit, which company described as being three to five years in future depending upon approval process. WMC purchased Yakabindie deposit with 292 Mt @ 0.52% Ni from Rio Tinto in 2001.

	WMC Resouces Limited	Kalgoorlie smelter	96 650	91 574	?	M

Remarks: Smelter takes feed from WMC Resources concentrators plus other sources; matte exported to Finland (OM, Group) and to Japan (Sumitomo); cobalt in residues shipped to Falconbridge plant at Nikkelverk for toll refining; Feb. fire in sulphuric acid plant briefly closed plant; output restricted by air quality issues due to reduced precipitator capacity; agreement with Jinchuan to supply 30 000 t Ni in matte over unspecified period starting in 2005. Agreement announced in January to smelt Emily Ann concentrate and ship matte to Canada may have been for very limited amount as Emily Ann shipped 40 000 t of nickel concentrate containing 5265 t of Ni to Inco in 2002.

	WMC Resouces Limited	Kwinana refinery	61 324	65 055	?	I

Remarks: Record output after recent upgrade; debottlenecking could take capacity to 70 000 t/y; conceptual plans to increase capacity to 80 000 t/y and beyond. Cobalt is toll refined by Falconbridge at Nikkelverk in Norway.

AUSTRIA	Treibacher Industrie AG	FeNi smelter	1 300	1 500	–	II

Remarks: Ni recovered from scrap and residues including catalysts from food industry.

BOTSWANA	BCL Limited	Mines, mill and smelter at Selebi Phikwe	(r) 19 000	20 000	270	M

Remarks: LionOre purchased Anglo American plc's ownership in BCL effective September 30 when LionOre acquired Tati Nickel (see below); LionOre owns 85% of operation with Government of Botswana owning remaining 15%. Smelter problems at BCL forced shut-down in the April-June quarter. Cobalt tonnage refers to cobalt in matte, which is exported for refining.

	Tati Nickel Mining Company (Proprietary) Limited	Selkirk u/g and Phoenix pit, newly commissioned convention flotation mill replacing dry magnetic mill	8 177	9 539	36	S

Remarks: LionOre purchased Anglo American plc's 43.35% ownership in Tati for US$76 million; Tati 3.6-Mt/y wet concentrator commissioning begun in Q2, construction was completed in 2002, reaching "near to design capacity" for December operation; Selkirk mine shut in Q3 when pillar recovery operations completed; LionOre acquired majority interest in BCL where Tati's output is smelted (shut-down in April 2002 because of equipment failure – see above); US$10 million feasibility study of Activox® process at Tati Nickel by end of 2003 and trial plant to be constructed in Australia for assembly and commissioning at Tati in early 2004 -- if successful, potential for commercial plant to be in operation by 2007, producing 17 000 t/y Ni metal.

BRAZIL	Codemin SA	Niquelandia mine, smelter	5 800	6 000	–	II

Remarks: Increased mining (+22%) and ore processed (+8%) feed resulted in increased production (+3%) of 6000 t Ni in FeNi; grade of ore processed dropped to 1.7% Ni from 1.8% in 2001; FeNi grades 27% Ni.

TABLE 6 (cont'd)

Country	Company	Operation	Nickel Output 2001	Nickel Output 2002	Cobalt in 2002	Type of Ni output
				(t)		
	Mineração Serra da Fortaleza Limitada	Fortaleza mine, mill, smelter	10 170	6 273	?	M
Remarks: Production reduced due to lower grade and ground problems, which forced closure of u/g mine from June to Sept.						
	Companhia Niquel Tocantins	Tocantins mine, ammonia leach plant at Niquelandia; refinery at Sao Paulo	16 700	17 675	960	I
Remarks: Expansion plan to 21 000 t/y Ni and 1100 t/y Co during 2004 confirmed in May; first stage to take capacity to 18 000 t by 2003; forecast production of 18 000 t in 2003 rising to 21 000 t in 2005. Expansion had been delayed due to electricity rationing but, as of mid-2002, company generated 50% of own power requirements. Production of nickel per INSG report of refined nickel production in Brazil, and cobalt production per Cobalt News 03/2 of the Cobalt Development Institute.						
CANADA	Canmine Resources Corporation	Cobalt hydrometallurgical refinery	–	minimal	minimal	Ch
Remarks: Hydrometallurgial refinery completed commissioning and was in process of optimizing operations when financial difficulties forced shut-down in July. Company placed under protection of Companies Creditors Arrangement Act to allow for opportunity for restructuring. No resolution by year-end; refinery stayed shut through year-end.						
	Falconbridge Limited	Raglan mine, mill	24 570	24 636	386	S
Remarks: Mill capacity increased from 0.8 to 1.0 Mt/y. All output shipped as Ni-Cu-Co concentrate from Deception Bay to Québec City and then railed to Falconbridge's smelter in Sudbury during the mid-June to mid-March shipping season. Reserves at year-end sufficient for about 18 years of production. Project started that will result in 100% recycling of mill water.						
	Falconbridge Limited	Sudbury - 4 u/g mines, mill, smelter	25 226	27 833	690	S
Remarks: Four mines feed a single concentrator; 2.3 Mt milled in 2002. A separate Cu concentrate is produced from high-copper ore and sent to Falconbridge's Kidd operation for processing. The bulk Ni-Cu concentrate is sent to company's smelter in Sudbury, which also processes recyclable Ni and Co. Exploration continued at the Nickel Rim South deposit located at 1600 m depth targetted at an inferred resource of 6.3 Mt @ 1.7% Ni, 3.4% Cu, 6.2 g/t Pd+Pt+Au; decision whether to sink exploration shaft expected in mid-2003. Existing ore reserves at yearend were sufficient for 8 yrs at targetted operating rate.						
	Falconbridge Limited	Montcalm deposit	–	–	–	SO
Remarks: Feasibility study ongoing at year-end; 7.7 Mt @ 1.39% Ni, 0.67% Cu and 0.06% Co could be mined at 750 000 t/y. Ore would be transported to Kidd Metallurgical Division for milling; concentrate would be smelted at company's smelter at Sudbury. Projected production of up to 8000 t/y of Ni. Decision expected in Q2 2003.						
	Inco Limited	Port Colborne refinery and processing facilities	–	–	(e) 1 200	
Remarks: Produces electrolytic cobalt metal, about 80% of Inco's Co production is produced as metal; capacity reported as 1360 t/y Co; upgrades PGMs, Au and Ag. Some nickel products from Sudbury and Thompson "finished" at Port Colborne. Class action suit filed for $750 million for past emissions being opposed by Inco. The Cobalt Development Institute reported total Inco production as 1480 t for 2002.						

	Inco Limited	Sudbury - 7 u/g mines, mill, smelter, matte processing, carbonyl refinery	61 200	68 700	see Port Colborne	I,II

Remarks: Produces pellets, powder and NiO sinter; cobalt recovered at Port Colborne; PGMs are sent to Inco facility at Acton in U.K.; NiO is sent to Inco's Clydach refinery in U.K. for recovery into pellets. Production data 33 800 t in 2002 produced at Clydach. NiO exported to South Korea and Taiwan for processing at refineries in which Inco has a share of ownership. Data shown here subtract estimated Clydach production (see below) from Inco's reported Ontario + UK production.

	Inco Limited	Thompson - 2 u/g mines, mill, smelter, electro-refinery	49 900	45 400	(e) 160	I

Remarks: Cathode, rondelles; 470-t/y capacity to produce Co oxide. Production includes nickel recovered from imported concentrates from Australia.

	North American Palladium Ltd.	Lac des Iles - open-pit mine, mill	724	1 254		S

Remarks: Ni and Cu by-products of Pd concentrate. Continuing problems achieving nameplate capacity after mid-2001 expansion from 2400-t/d to 15 000-t/d mill; optimizing work undertaken on SAG mill; damage to new crusher discovered in Sept. resulted in lost production; studies under way to increase Pd recovery by finer grinding.

	The Cobalt Refinery Company Inc.	Hydrometallurgical nickel-cobalt refinery, produces about 250 000 t/y of by-product fertilizer	29 225	31 694	3 065	I

Remarks: Company owned 50% by Sherritt International Corporation and 50% by General Nickel Company S.A. (the latter a state-owned Cuban company). Operation processes Ni-Co residue from pressure leach operation located at Moa Bay in Cuba (see entry); high-grade residue containing about 50% Ni shipped to eastern Canada and then railed to Fort Saskatchewan, Alberta, for processing along with small amounts of material from third parties to recover Ni and Co in form of briquettes and powder. Record annual Ni and Co production at refinery. Sherritt is considering an expansion of operations at Moa and Fort Saskatchewan.

CHINA	Cu-Ni mine (company name unknown)	Tonghua Cu-Ni mine	(e) 500	(e) 500	?	S

Remarks: Cu-Ni mine; reported production of about 500 t/y of nickel in concentrates.

	Ni mine (company name unknown)	Huili Nickel mine and smelter	?	?	?	M

Remarks: Reportedly a mine and smelter with capacity of about 1400 t/y Ni.

	Jilin Nickel Co.	3 mines, smelter, refineries	?	?	?	M,I

Remarks: Capacity reported between 9500 t/y Ni in matte and 1000 t/y Ni cathodes plus 3500 t/y Ni hydroxide; recent production data not available; production in 1998 said to be about 5000 t Ni; smelts Ni concentrate from other producers. Company web site reports owning three nickel mines, two smelters, three refineries and two chemical plants amounting to largest installed capacity to produce nickel suphate.

	Jinchuan Nonferrous Metals Corporation	Mines, mill, smelter, refinery	(e) 50 000	(e) 48 000	(e) 1000	I, Ch

Remarks: Jinchuan has ambitious plans to increase production to 100 000 t/y of nickel by 2006 but lacks mine capacity to sustain this level of refined production. Company has held talks with Anaconda, Heron Resources and Weda Bay about possible cooperation/development. Titan Resources continued negotiation of joint venture to test BioHeap leaching at Jinchuan. Jinchuan and Sally Malay reached agreement for off-take contract for new 8000-10 000 t/y Ni in concentrate production. Contract with Cubaniquel for supply of nickel and cobalt in intermediate sulphides since 2001.

TABLE 6 (cont'd)

Country	Company	Operation	Nickel Output 2001	Nickel Output 2002	Cobalt in 2002	Type of Ni output
				(t)		
	Sichuan Copper-Nickel Co.	Chengdu refinery	?	?	?	I
Remarks: Refinery; capacity and output unknown.						
	Simsen Metals (Holdings) Ltd.	Mine	?	(e) 500	?	S
Remarks: Started up in 1999; ships concentrate to Jinchuan; forecast from 1999 that production would be 1500 t contained Ni in 2000; estimated production of 500 t of nickel in concentrates in 2002 with 2001 likely less.						
	Xinjiang Nonferrous Metals Industry Corporation	Kalatongke	(e) 1 900	?	?	M,I
Remarks: Ni-Cu mine, smelter, refinery.						
COLOMBIA	Cerro Matoso S.A.	Cerro Matoso mine, FeNi smelter	38 500	44 000	–	II
Remarks: Expansion completed in Jan. 2001 when second processing line started up; mine reserves grade 2.2% Ni; bulk of FeNi output shipped to Europe.						
CUBA	Union del Niquel	Commandante Ernesto Che Guevara Mining and Metallurgical Combine (Punta Gorda) mine and refinery	(e) 32 200	(e) 30 000	(e) 1 000	II,S
Remarks: Program to reduce production costs by converting to domestic high sulphur oil (imported oil costs represented 55% of operating costs); in addition to Ni oxide, plant increasing by-product output of mixed Ni-Co sulphides production; plans to expand operation to range of 50 000 to 55 000 t/y, possibly drawing on some of resources of Las Camariacas; exports Co concentrate (mixed Ni-Co sulphides?) to China.						
	Union del Niquel	Commandante Rene Ramos Latour Mining and Metallurgical Combine (Nicaro) mine and refinery	(e) 11 000	(e) 9 000	–	II
Remarks: Older plant with high energy costs; output limited by depletion of nearby orebodies; 11-km converyor system to new mining areas scheduled for completion by 2005, which could allow production to rise to 17 000 t Ni in NiO.						
	Moa Nickel S.A.	Pedro Sotto Alba mine, PAL (e)	(e) 29 400	(e) 30 600	(e) 2 750	T
Remarks: Cuban government stated goal of expanding production to range of 50 000-55 000 t/y at Moa; operation output increasing due to mining new orebodies and de-bottlenecking; mixed Ni-Co sulphides exported to Fort Saskatchewan refinery (ratio of Ni:Co output for Fort Saskatchewan refinery used to estimate Ni and Co tonnage, data rounded and approximate).						

DOMINICAN REPUBLIC	Falconbridge Dominicana, C. por A.	Falcondo mine, FeNi smelter	27 800	23 300	–	II

Remarks: Plant re-opened in Jan. after being shut in Oct. 2001 for economic reasons; new contract signed with workers; power plant maintenance Oct.-Dec. and problems obtaining oil supplies in Dec. due to Venezuelian strikes cut production to 22 500 t compared to forecast of 24 000 t.

FINLAND	Mondo Minerals Oy	Lahnaslampi mine, Horsmanaho mine	(e) 200	?	?	S

Remarks: Talc operations produce flotation concentrate of pyrrhotite and pentlandite. Company has produced at least since 1990. Concentrate grades between 8% and 9% Ni.

	Outokumpu Oyj	Hituri mine, mill	2 600	2 500	?	S

Remarks: Mine produced 600 000 t of ore. Concentrate sent to Harjavalta smelter in Finland. OMG made agreement with Outokumpu in 2001 to maintain operation of mine for feed to OMG's refinery at Harjavlta.

	Outokumpu Oyj	Harjavalta smelter	?	?	?	M

Remarks: Matte is sent to OMG refinery on site. Concentrate supplied from Black Swan operation in Australia, Hituru mine in Finland, Nikkel og Olivin and Titania in Norway. Trade data (imports reported by Finland and exports reported by Australia) conflict such that calculation of output was not possible.

	OMG	Kokkola Chemicals Oy	–	–	8 200	n.a.

Remarks: Production cut in fourth quarter by 20% following OMG's re-evaluation of inventory. Company-wide production of cobalt cut in 2002 by 1100 t. Facility located on land owned by Outokumpu Zinc Oy. OMG production in 2002 shown as 8200 t by Cobalt Development Institute. Output is cobalt chemicals and refined cobalt.

	OMG Harjavalta Nickel Oy	Harjavalta refinery	(e)(r) 55 300	(e) 55 350	?	I

Remarks: OMG does not release production data. In addition to feed from the Harjavalta smelter, refinery receives matte feed from Fortaleza in Brazil and WMCR in Australia plus mixed Ni-Co hydroxides from Cawse PAL in Australia. Company revalued inventory in 2002 and began restructuring, which included ending agreement with Weda Bay Minerals, Inc. to fund feasibility study for development of 30 000 t/y Ni + 3000 t/y Co project, which could have supplied intermediate feed to Harjavalta refinery. Company stated that it had agreements in place in late 2002 covering 90% of projected nickel feed requirements for 2003 and 2004. OMG reduced Ni inventory by 5500 t during 2002 and nickel inventories for 2003 to be reduced by 3850 t. Production estimated using INSG data for Class I nickel production in Finland for 2002. 2001 production estimate revised from 54 600 t.

FRANCE	The Eramet Group	Sandouville refinery	13 033	11 444	175	I,Ch

Remarks: Plant output decreased due to drop in demand for high-purity nickel by aerospace industry. Plant processes matte from Doniambo smelter in New Caledonia to produce nickel and cobalt chemicals and high-purity Ni.

FORMER YUGOSLAV REPUBLIC OF MACEDONIA	Feni-Mak	Feni-Mak mines, FeNi smelter	3 000	5 100	–	II

Remarks: Production as shown in INSG statistics; plant purchased in 2000 by Feni-Rudnici i Industrija za Nikel, Celik i Antimon (FENI) of France.

TABLE 6 (cont'd)

<table>
<tr><th rowspan="2">Country</th><th rowspan="2">Company</th><th rowspan="2">Operation</th><th colspan="2">Nickel Output</th><th rowspan="2">Cobalt in 2002</th><th rowspan="2">Type of Ni output</th></tr>
<tr><th>2001</th><th>2002</th></tr>
<tr><td></td><td></td><td></td><td colspan="2">(t)</td><td></td><td></td></tr>
<tr><td>GREECE</td><td>General Mining and Metallurgical Co. S.A. (LARCO)</td><td>Mines, FeNi smelter</td><td>19 600</td><td>19 200</td><td>–</td><td>II</td></tr>
<tr><td colspan="7">Remarks: LARCO produces FeNi from three main domestic mining areas (Agios Ioannis, Evvia and Kastoria). Company has imported material from Albania in past few years, but no recent information whether imports continue. Agreement with European Nickel plc to import about 500,000 t/y of nickel laterite ore from Çaldag deposit in Turkey after 2002 (ore grades about 1.4% Ni). Capacity of LARCO estimated at 22,000 t/y of Ni in FeNi.</td></tr>
<tr><td>INDONESIA</td><td>PT Antam Tbk</td><td>Gebe, Pomalaa, Gee, Buli mines</td><td>(e) 49 000</td><td>(e) 60 000</td><td>?</td><td>L</td></tr>
<tr><td colspan="7">Remarks: Total production was 4.4 Mt (wet) vs. 3.6 Mt (wet) in 2001. Production was 1.15 Mt (wet) exported to BHP Billiton plc's Yabulu hydrometallurgical refinery in Queensland, Australia, and 3.25 Mt (wet) of saprolitic ore. Saprolitic ore is sent to company's FeNi smelters as well as being exported to Japanese FeNi smelters. (Ni content of ore mined estimated using reported reserve grades and moisture contents for reserves - note that estimates will vary from actual Ni contained if ore mined was not at average grade and moisture contents.) Cobalt may be recovered from ore sent to Yabulu. Antam began selling new product to Yabulu called low-grade saprolite ore (LGSO) from Pomalaa mine to offset some production of low-grade limonitic ore.</td></tr>
<tr><td></td><td>PT Antam Tbk</td><td>Pomalaa FeNi I and FeNi II plants, smelter lines</td><td>10 302</td><td>8 804</td><td>–</td><td>II</td></tr>
<tr><td colspan="7">Remarks: Production decreased due to labour interruption and two smelter shut-downs for repairs at the FeNi II unit kiln and power plant. Feed grade of ore to FeNi smelter is about 2.4% Ni. Company has toling agreement with Pacific Metals Co of Japan. Financing for expansion of FeNi capacity to 26,000 t/y Ni in FeNi approved by shareholders in June whereby assets pledged as collateral and German Export Credit Agency to insure US$ 240 million in loans from banks, US$ 75 million to be obtained from domestic banks and remainder of US$ 390 million to come from Antam's equity. Project anticipated to begin in March 2003.</td></tr>
<tr><td></td><td>PT International Nickel Indonesia Tbk (PT Inco)</td><td>Soroako mine, smelter</td><td>62 600</td><td>59 500</td><td>–</td><td>M</td></tr>
<tr><td colspan="7">Remarks: Five-month furnace rebuild brought forward to September when canal leak forced temporary shut-down. Plant demonstrated operation at rated capacity of 68 000 t/y during December quarter. Ore grade increased to 1.77% Ni from 1.69% Ni in 2001 and stripping rate increased to expose more ore. Agreement with PT Antam to develop East Pomalaa orebody as feed source for Antam's FeNi smelters, delivering 1 Mt/y of saprolitic ore for US$7/wet tonne based upon a mining cost of US$ 4/wet tonne.</td></tr>
<tr><td>JAPAN</td><td>Hyuga Smelting Co., Ltd.</td><td>FeNi smelter at Hyuga, Miyazaki Prefecture</td><td>21 800</td><td>(e) 19 000</td><td>–</td><td>II</td></tr>
<tr><td colspan="7">Remarks: Owned 60% by Sumitomo; intention to expand production to 25 000 t/y Ni in FeNi from current 19 000 t/y announced in 2000, no construction reported in 2002; obtains feed from New Caledonia and Indonesia.</td></tr>
<tr><td></td><td>Inco TNC Limited</td><td>Nickel refinery located at Matsauzka, Mie Prefecture</td><td>(e) 48 000</td><td>(e) 49 000</td><td>–</td><td>II</td></tr>
<tr><td colspan="7">Remarks: About 20% of total PT Inco Ni matte sent to Sumitomo for refining to metal with remainder going to Inco TNC for conversion to NiO, which is used in stainless steel industry in Japan and as feed to Ni refineries in Korea and Taiwan (in which Inco has interests). Production estimate based upon quantity of finished Ni reported produced from PT International Nickel less deliveries to Sumitomo.</td></tr>
</table>

	Nippon Yakin Kogyo Co., Ltd.	FeNi smelter at Oheyama, Kyoto Prefecture	12 445	12 400	–	II
Remarks: Produces FeNi from imported ore from New Caledonia and Indonesia (PT Antam).						
	Pacific Metals Co., Ltd.(Pamco) Prefecture	FeNi smelter at Hachinohe, Aomori	42 000	(e) 40 500	–	II
Remarks: Has toll smelting arrangement with PT Antam. Produces FeNi from ore imported from Indonesia and Philippines. Ore contract was suspended by New Caledonian producer SMSP in early 2001.						
	Sumitomo Metal Mining Co., Ltd.	Electroytic refinery at Niihama, Ehime Prefecture	32 526	32 300	355	I
Remarks: Plant capacity to be increased from 36 000 t/y Ni to 45 000 t/y Ni by mid-2004 to handle additional feed including material from Coral Bay Nickel project in Philippines. Sumitomo apparently had been ready to purchase a 25% share of the Goro project in New Caledonia, but this was halted due to the anticipated cost-overruns at the project, which resulted in the suspension of Goro pending a re-evaluation. Capacity could be increased to as high as 60 000 t/y Ni and 1100 t/y Co.						
KAZHAKSTAN	Kempirsai Mining Directorate	Laterite mines	?	?	–	L
Remarks: No information available about production; mines thought to be inactive.						
NEW CALEDONIA	Sociète des Mines de la Tontouta (SMT)	Nakety, Moneo and Karenbe mines and Nakety/Bogata project with Argosy/Norilsk	?	?	–	L
Remarks: Exported 956 000 t of garineritic ore to Sumitomo's FeNi smelter in Japan in 2002. MMC Norilsk Nickel terminated purchase agreement with Argosy Minerals Inc. to buy into the Nakety/Bogota project.						
	Le Nickel-SLN	Doniambo FeNi smelter	58 973	59 867	?	II, M
Remarks: Expansion plans to take production at Doniambo smelter to 75 000 t of Ni in FeNi. Doniambo is already the world's largest FeNi smelter. Part of output is in form of nickel matte, which is sent to France for refining. Output in 2002 was 11 323 t Ni in matte and 47 799 t Ni in FeNi. Cobalt recovered in France and presumably contained in matte exported.						
	Le Nickel-SLN	Kouaoua, Nepoui Kopeto, Tiebaghi, Thio, and Poro mines	?	?	?	L
Remarks: Mines produced 2.6 Mt of garnieritic ore. SLN exported 166 000 t of garneritic ore to Nippon Yakin and Sumitomo FeNi smelters in Japan as well as 475 000 t of limonitic ore to BHP Billiton plc's QNI refinery in Australia.						
	La Société Minière du Sud Pacifique S.A.	Various mines on both coasts and Koniambo project with Falconbridgeincluding	(e) 6500 including limonite exports	(e) 6500 including limonite exports	?	L
Remarks: Owned by investment agency of the Northern Province. Exports were 440 000 t (wet) of high-grade ore in 2001 and in 2002. Principal customers were Sumitomo (Hyuga plant) and Nippon Yakin in 2002. Company also ships limonitic ore to QNI in Australia. SMSP holds 51% of Koniambo project being studied by Falconbridge (60 000 t/y of Ni in FeNi planned).						

TABLE 6 (cont'd)

Country	Company	Operation	Nickel Output 2001	 2002	Cobalt in 2002	Type of Ni output
				(t)		
	Société Minière Georges Montagnat S.A.	Tontouta open pit	(e) 3500 not including limonite expots	(e) 2500 not including limonite exports	–	L
Remarks: Leases Tontouta pit from SLN; exported 169 000 t in 2002 to Japanese FeNi smelters compared to 225 000 t in 2001. Also ships limonitic ore to QNI in Australia.						
NORWAY	Nikkel og Olivin A/S	Mine, mill	2 500	1 700	(e) 80	S
Remarks: Mine ceased operation Oct. 18 due to depletion of ore; total production from 1989 to 2002 was 32 500 t of Ni, 9140 t of Cu and 1530 t of Co in concentrates.						
	Falconbridge Nikkelverk Aktieselskap	Nikkelverk refinery	68 221	68 533	3 994	I
Remarks: Refinery established new production record for Ni and other metals during Q3; forecast production of 72 000 t of Ni in 2003 with increased custom feed (note: based upon doubling of Tati Nickel concentrate production, which is sent to BCL and then to Nikkeverk); plant capacity of 85,000 t/y Ni, 40 000 t/y Cu, and 4500 t/y Co was confirmed during Q3; company could expand operation to 100 000 t/y Ni, 60 000 t/y Cu and 5000 t/y Co if market conditions warrant. Falconbridge approached by Fox Resources Limited about possible plans to produce intermediate feed to be produced from sulphuric acid leach of 50 000-t ore stockpile at former Radio Hill mine. Plant produced 11 t of PGMs in 2002 compared to 7.3 t in 2001. Falconbridge cobalt production includes toll refined material from WMC Resources, secondary feed and any cobalt recovered from BCL matte.						
	Titania A/S	TiO, magnetite mine	400	(e) 400	?	S
Remarks: By-product low-grade Ni concentrate is sent to Outokumpu's smelter at Harjavalta, Finland.						
PHILIPPINES	Cagdianao Mining Corporation	Mine	3 000	?	–	L
Remarks: No public information is available about mine production in 2002. All Ni mines in Philippines together are reported to have produced 24 000 t of Ni in ore in 2002.						
	Coral Bay Nickel Corporation	Mine/HPAL plant	–	–	–	S
Remarks: Project under construction for completion in late 2004. Sumitiomo's HPAL process to take stockpiled limonitic ore as feed to produce intermediate sulphides containing about 10,000 t/y of Ni and 700 t/y of Co to be processed at Sumitomo's refinery in Japan. Delays due to environmental concerns. Project owned 54% by Sumitomo, 18% by Mitsui & Co, 18% by NIssho Iwai and 10% by Rio Tuba Nickel Mining Corporation (itself owned 27% by Pacific Metals Corporation, plus 4%-5% by each of Nippon Steel, Nisshin Steel, and Nissho Isai).						
	Hinatuan Mining Corporation	Mine	–	–	–	L
Remarks: Mine believed to remain closed (since 2000). Permission to ship stockpiled ore was denied in 2001. No further information available.						

	Rio Tuba Nickel Mining Corporation	Rio Tuba mine	4 350	?	–	L

Remarks: Company part owner of Coral Bay Nickel HPAL project (see entry). No public information about Rio Tuba production in 2002 available. All Ni mines in Philippines together are reported to have produced 24 000 t of Ni in ore in 2002.

	Taganito Mining Corporation	Mine located in Suriago del Norte	13 000	?	–	L

Remarks: No public information about mine production in 2002 available. All Ni mines in Philippines together are reported to have produced 24 000 t of Ni in ore in 2002.

RUSSIA	MMC Norilsk Nickel	Taimyr Peninsula - 7 mines, 2 mills, 2 smelter/refineries (see mine names below in notes)	?	?	?	I,M

Remarks: Mines produced 13 Mt and were source of most of company's nickel, copper, cobalt and all PGMs. Division mined 13 Mt of ore in 2002. Outokumpu involved in ongoing modernization of smelters and refineries. In 2001, Oktaybrsky mine was most important of producing mines, accounting for half the nickel and 53% of PGMs produced by Arctic Division. Author estimates that Arctic Division was source of about 180 000 t of finished Ni produced by the company.

	MMC Norilsk Nickel	Pechanganickel in Kola Peninsula - 3 mines, mill, agglomeration plant, smelter (see mine names below in notes)	?	?	?	M

Remarks: Ni tonnage is estimate of finished nickel production originating in Kola mines. Division produced 7 Mt of ore. Matte from Nikel smelter near mines shipped to Severonickel for refining. Modernization of smelter begun in 2001 after grant of US$31 million from Norwegian government and US$30 million credit from Nordic Investment Bank. Severny-Glubkoy mine is focus of investment in division. Author's estimate that Kola supplies about 35 000-40 000 t of finished nickel produced by Norilsk in 2002.

	MMC Norilsk Nickel	Severonickel refineries in Kola Peninsula	?	?	?	I

Remarks: Processes matte from Pechanganickel's Nikel smelter plus matte from Arctic Division, plus domestic and imported scrap and recyclables, including auto catalysts; some carbonyl nickel production.

	MMC Norilsk Nickel, all divisions		223 000	218 000	4 200	I

Remarks: Mine production was 20 Mt @ 1.40% NI, 2.14% Cu, 5.94 g/t PGMs in 2002. Production forecast is 240 000 t for 2003. Investment plan to 2015 approved in December, allocating US$125 million per year in Arctic Division, US$25 million per year in Kola operations (likely mines) plus US$30 million per year in milling. In addition, US$80 million per year for smelter improvements over five years. In May, Norilsk obtained permission to sell PGMs directly to customers. Norilsk is the world's largest producer of nickel and palladium. For more details about operations, see company annual report for 2002 at www.nornik.ru/upload/findocs/2003/MMC_2002_AR_Eng.pdf.

	Rezh Nickel Plant Joint Stock Company	Talovsk mine, smelter	4 400	2 823	?	M

Remarks: Plant re-opened in April after five-month shut-down. Reportedly two of four furnaces in operation by July. Trial shipment of 300 t of Ni matte to Jinchuan Nickel in China reported.

	Ufaleynikel Joint Stock Co.	Ufaley and Serovskoye mines, refinery	(e) 9 500	6 500	2 100	II, I

Remarks: Plant closed in Q3 of 2001 due to low nickel prices; nameplate capacity of 17 000 t/y Ni as granules and in FeNi unlikely achievable, and effective capacity estimated at about 7000 t/y of Ni in granules from Rezh matte; tolls Co to produce metal and oxide (possible double counting with respect to Norilsk output); status of Ni laterite mines at Ufalei and Serov unknown.

TABLE 6 (cont'd)

Country	Company	Operation	Nickel Output 2001	Nickel Output 2002	Cobalt in 2002	Type of Ni output
				(t)		
	Yuzhuralnikel Kombinat Joint Stock Co.	Buruktalskoye mine (Orenburg region) and Sakharinskoye mine (Chelyabinsk region)	(e) 13 600	18 400	?	L
Remarks: Production 70% Ni and 30% Ni in FeNi. Mechel Steel Group owns 70% of operation. Feb. 2002 report that production for month had risen to 950 t of Ni after repair and restart of another furnace. Company likely supplying Ni for Mechel opeations. Production estimate updated for 2001.						
SERBIA-KOSOVO	Ferro-Nickel D.D. Glogovac	Cikotava and Gllavica laterite mines and FeNi smelter near Pristina	–	–	–	II
Remarks: Plant believed to be inactive during 2002.						
SOUTH AFRICA	Anglo American Platinum Corporation Limited	Underground and open-pit mines, smelters, base-metal and precious-metal refineries	19 500	19 400	–	I
Remaks: Nickel is a by-product of mining PGMs. Company's expansion program to 2006 will increase company's nickel output to 33 000 t/y at "steady state." New mines under development, UG2 concentrator to be expanded; Polokwane smelter expected to be completed in late 2003. Anglo Converting Process (ACP) to replace Pierce Smith convertors with Austmelt technology allowing increased sulphur dioxide capture.						
	Anglovaal Mining Limited, Anglo American plc	Nkomati JV mine/mill	4 400	5 025	60	S
Remarks: Cobalt data refer to "sold" material and contained Co could be twice this value; environmental permitting for expansion to 16 000 t/y refined Ni output continuing at year-end; company also examining"various alternatives." Expansion project to 16 000 t/y Ni and 900 t/y Co plus copper and PGMs apparently continues to be delayed.						
	Impala Platinum Holdings Limited	Various mines, smelter and base-metals refinery in Bushveld complex	(e) 13 500	(e) 13 900	–	I
Remarks: Ni is by-product of PGM operations; Impala supplements own feed with tolled and purchased concentrates processed by Impala Refining Services (IRS); FY 2003 nickel production was 8000 t from own mines plus 6700 t from tolled and refined concentrates. Plan to study expansion of Ni refinery to handle 40 000 t/y Ni and 4000 t/y Co in iintermediates from potential revival of Nonoc operation on hold. Handles nickel in PGM concentrates from Zimbabwean mines. Calendar year production estimated based on average fiscal year production rates.						
	Lonmin plc	Eastern Platinum Limited, Western Platinum Limited mines, smelter and refinery	?	?	–	Ch
Remarks: Ongoing US$500 million expansion; Ni is by-product of PGM operation; INSG put capacity at 3000 t/y Ni as Ni sulphate; production data not released; Lonmin plans expansion of platinum production by about 50% from 2001 levels, implying some increase in Ni by-product production can be expected.						

	Northern Platinum Limited	Mines, mills, smelter, base-metal removal plant	1 400	(e) 1 400	–	Ch
Remarks: Ni is by-product of PGM operation; produces approximately 1400 t/y Ni in concentrate, which is sold in form of Ni sulphate to Anglo American Platinum Corporation Limited.						
SOUTH KOREA	Korea Nickel Corporation	Onsan refinery	28 000	29 000	–	II
Remarks: Produces Class II Ni (UTILITY TM grade at 97%); feed includes NiO feed from Inco Sudbury operation and Inco TNC in South Korea as well as Australia and Russia. Imports of NiO during 2002 were 40 000 t gross weight equal to about 31 500 t of contained Ni.						
SPAIN	Rio Narcea Gold Mines, Ltd	Aguablanca project	–	–	–	S
Remarks: Company completed bankable feasibilty study for nickel sulphide mine/mill to produce up to 10 000 t/y of nickel in concentrate. Financing for US$64 million project secured in Dec.						
TAIWAN	Taiwan Nickel Refining Corporation	Transforms NiO to make UTILITY™ Ni (97% Ni) at Kaohsiung Hsien	(e) 10 000	(e) 13 400	–	II
Remarks: Transforms NiO UTILITY™ Ni; plant output estimated assuming 76% Ni in feed and 99% recovery in process with no changes in inventory; data are not released.						
TURKEY	European Nickel plc and As Krom through Bosphorus Nickel	Çaldag mine	–	–	–	L
Remarks: Mine purchased by European Nickel plc in late 2002; contract with LARCO for 500 000 t/y of laterite ore planned to start after Nov. 2002 (resource grade is 1.4% Ni with approximately 0.05% Co). European Nickel plans heap leaching tests using 5000 t of ore and technology similar to that developed by Titan Resources. Target is to produce 20 000 t/y of Ni-Co sulphides annually.						
UKRAINE	Nikomed Limited	Pobuzhsky Ferronickel Works	1 500	–	–	II
Remarks: Plant was planning to receive 0.5 Mt laterite ore from SMSP but no details of trade found. Plant reported under rehabilitation in mid-2003 indicating that it probably did not operate in 2002. Test shipment of 90 000 t ore in 2001 could have allowed production test of about 1500 t in 2001.						
UNITED KINGDOM	Inco Limited	Clydach carbonyl refinery	33 800	33 300	–	I
Remarks: Takes NiO from Sudbury to produce Ni pellets, foams and powders; residue from refining is returned to Sudbury for reprocessing; data shown are INSG production reported for U.K. These data are counted by Inco in Ontario division production totals.						
UNITED STATES	Stillwater Mining Company	Mines, mill, pgm smelter/refinery	358	639	–	Ch
Remarks: Palladium operation producing by-product nickel sulphate, which is shipped to Canada for recovery. Norilsk Nickel made offer to purchase 51% ownership in Stillwater in November for US$100 million cash and US$240 million in palladium inventory.						
VENEZUELA	Minera Loma de Niquel, C.A.	Loma de Niquel mine, FeNi smelter	9 700	15 500	–	II
Remarks: Mining increased to 1.3 Mt with 1.1 Mt @ 1.7% being processed to yield 15,500 t Ni in FeNi (FeNi grade is 27% Ni).						

TABLE 6 (cont'd)

Country	Company	Operation	Nickel Output 2001	 2002	Cobalt in 2002	Type of Ni output
				(t)		
ZIMBABWE	Bindura Nickel Corporation Limited	Trojan and Shangani mines, smelter, refinery	7 400	7 750	?	I
Remarks: As Bindura operates the only nickel mines in the country, INSG data for country mine production used as estimate of company's mine production. Company tolls matte plus recovers undetermined tonnage of nickel from chemicals from South Africa. In December Bindura warned that company would close unless currency controls were modified (2001 data updated to reflect INSG mine production data for Zimbabwe).						
	Rio Tinto Zimbabwe Limited	Empress refinery	6 635	6 412	?	I
Remarks: Toll refines matte from BCL by leaching and electrowinning.						
	Mimosa Mining Company (Pvt) Limited	Mine/mill	(e) 200	413	–	S
Remarks: PGM operation producing by-product nickel. Output sent to Impala for refining. Expansion to increase PGM production by 400% to be completed in late 2003. Impala and Aquarius Platinum Lilmited each own 50% of Mimosa's parent company, ZCE Platinum Limited. Production for 2002 and estimate for 2001 are for financial years ending in mid-2003 and mid-2002, respectively.						
	Makwiro Platinum Mines (Private) Limited (owned by Zimbabwe Platinum Mines Limited	Ngezi mine and Selous metallurgical complex mill and smelter	–	929	–	M
Remarks: PGM operation producing by-product nickel and copper. Nickel in ore grades in order of 0.1% Ni. 1.6 Mt open pit ore hauled to Selous flotation concentrator (at former Hartley mine, now closed). Concentrate smelted and matte sent to Impala for recovery in South African refinery. Nickel sales reported and production estimated to be higher than sales in 2002.						

Sources: Various web sites and press releases as well as commercial publications.
(e) Author estimate; n.a. Not applicable.
Ch = Ni content in Ni chemicals; Co = cobalt; FeNi = ferronickel; I = Class I Ni (e.g., cathodes, briquettes, pellets, powders, etc., which have a Ni content of 99% or more); II = Class II Ni (e.g., products with a Ni content of less than 99% such as FeNi, NiO, UTILITY^{TM} Ni); L = laterite ore; M = matte; NiO = nickel oxide; S = sulphide concentrates; SO = sulphide ore mined; T = Ni intermediates such as Ni carbonates, Ni sulphides or Ni hydroxides.

** In December, WMC Limited was split into two entities: Alumina Limited and WMC Resources Ltd. The latter contains the metals assets of the former WMC Limited.

Notes: Cobalt Development Institute data for cobalt production used when producer data not available or are listed as sales or deliveries.
Norilsk mines nickel in two divisions: the **Arctic division** in the Taimyr Peninsula and the Kola Peninsula. The deposits and mines in the Arctic division are: Oktabrysky deposit -- mined by Otkaybrsky mine and Taimyrsky mine, both underground operations; Talknak deposit -- mined by Komsomolsky, Mayak and Skalistaya mines, all underground mines; the Skalistaya mine is under construction and may be delivering only development ore to the mills; Norilsk 1 deposit -- mined by Zapolyarny underground mine and Medvezhy Ruchey open-pit mine. The deposits mined in the **Kola peninsula** are: Zhdanovskoye deposit - mined by Tsentralny open pit and the Severny Gluboky underground mine, the latter under development. Zapoloyarnoe deposit -- mined by Severny mine and Kaul-Kotselvaara underground mines.

TABLE 7. CANADIAN NICKEL PROCESSING CAPACITY, 2002

	Smelter	Refinery
	(t/y of contained nickel)	
Falconbridge Limited		
Sudbury, Ontario	70 000	n.a.
Inco Limited		
Sudbury, Ontario	100 000	59 000
Sudbury, Ontario (1)	18,000	n.a.
Thompson, Manitoba (2)	n.a.	55 000
The Cobalt Refinery Company Inc.		
Fort Saskatchewan, Alberta	n.a.	32 000
Canmine Resources Corporation (3)		
Cobalt, Ontario	n.a.	300

Source: Natural Resources Canada.
n.a. Not applicable.
(1) Produces nickel oxides sinter. (2) Thompson smelter capacity listed at 63 000 t/y in 2001. (3) Plant shut by financial problems before capacity could be established; production to have been by-product nickel in salts.

TABLE 8. WORLD MINE PRODUCTION OF NICKEL,(1) 1998-2002

	1998	1999	2000	2001	2002
			(000 tonnes)		
Russia	235	235	235	235	237
Australia	144	119	(r) 166	205	189
Canada	208	186	191	194	188
New Caledonia	125	(r) 110	118	118	100
Indonesia	74	89	98	102	122
Cuba	68	67	(r) 71	77	77
Colombia	29	39	59	53	58
China	48	50	51	52	55
Brazil	33	33	(r) 36	34	36
South Africa	36	36	37	36	39
Other (14 countries)	117	93	112	119	130
Total	1 117	(r) 1 058	(r) 1 174	1 224	1 229

Source: INSG *World Nickel Statistics* (October 2003).
(r) Revised.
(1) Ni content of sulphide concentrates or Ni content of lateritic ore mined.
Notes: Totals may not add due to independent rounding.

TABLE 9. WORLD PRODUCTION OF PRIMARY NICKEL, 1998-2002

	1998	1999	2000	2001	2002
			(000 tonnes)		
Russia	227	228	(r) 221	252	239
Japan	127	134	161	154	158
Canada	147	124	134	141	145
Australia	80	79	111	128	132
Norway	70	74	59	68	69
China	40	45	51	50	54
New Caledonia	45	45	44	46	49
Cuba	39	39	40	41	41
United Kingdom	36	36	(r) 37	33	39
South Africa	39	38	38	34	34
Dominican Republic	21	23	23	23	24
Other (13 countries)	165	158	165	191	198
Total	1 035	1 024	1 083	1 160	1 179

Source: INSG *World Nickel Statistics* (October 2003).
(r) Revised.

TABLE 10. WORLD USE[1] OF PRIMARY NICKEL, 1998-2002

	1998	1999	2000	2001	2002
			(000 tonnes)		
Japan	169	183	200	162	191
United States	150	152	150	129	115
Germany	97	101	104	110	110
Taiwan	42	47	62	83	92
South Korea	70	89	(r) 90	81	91
China	68	81	78	75	83
Italy	53	55	(r) 53	57	67
France	55	52	(r) 50	51	53
Spain	31	38	38	44	47
Finland	37	41	43	39	41
Other (more than 25 other countries)	274	244	256	273	282
Total	1 009	1 082	1 123	1 104	1 171

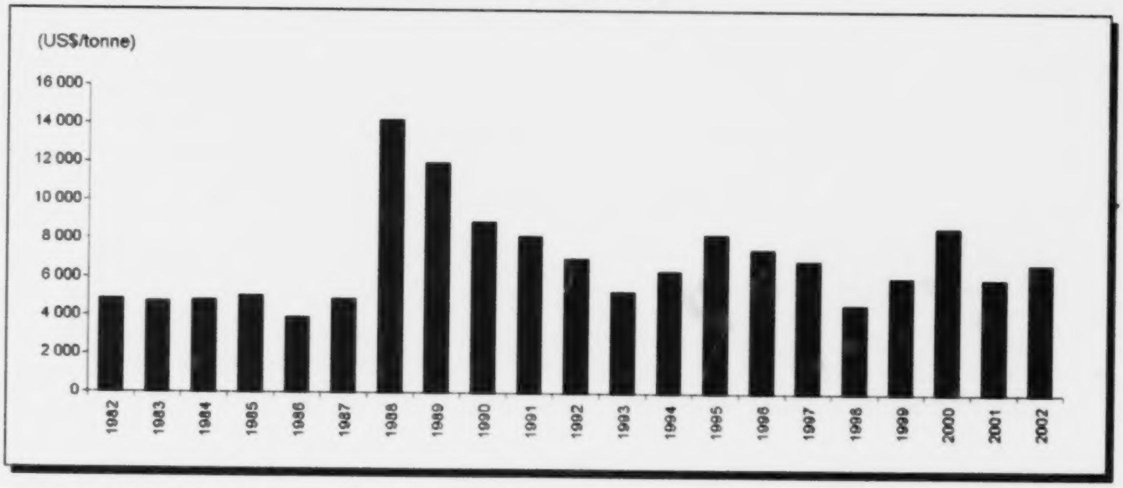
Source: INSG *World Nickel Statistics* (October 2003).
(r) Revised.
(1) The term "use" replaces "consumption" to reflect the fact that nickel is not being "used up" in its applications; over 500 000 t/y of nickel is recycled yearly, which is not included in the above data.

TABLE 11. AVERAGE ANNUAL NICKEL PRICES, 1981-2002

	Settlement Price	
	(US$/t)	(converted to US$/lb)
1981	5 985	2.71
1982	4 808	2.18
1983	4 695	2.13
1984	4 783	2.17
1985	4 987	2.26
1986	3 887	1.76
1987	4 849	2.20
1988	14 206	6.44
1989	11 955	5.42
1990	8 880	4.03
1991	8 158	3.70
1992	7 000	3.18
1993	5 283	2.40
1994	6 344	2.88
1995	8 237	3.74
1996	7 500	3.40
1997	6 916	3.14
1998	4 617	2.09
1999	6 015	2.73
2000	8 641	3.92
2001	5 948	2.70
2002	6 772	3.07

Sources: INSG *World Nickel Statistics* (various issues); London Metal Exchange; *Metal Bulletin*.

LME Settlement Nickel Price, Annual Average, 1982-2002



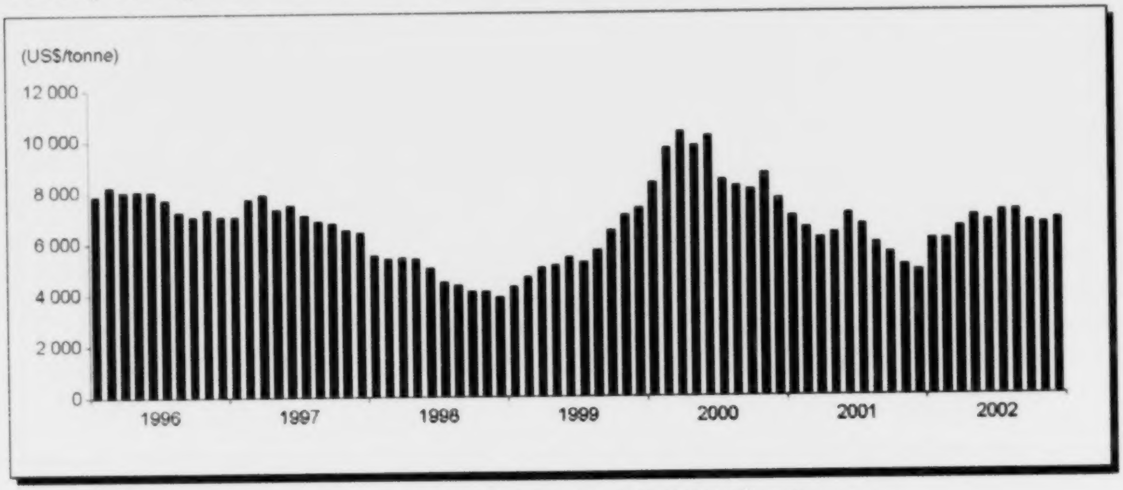
Sources: *Metal Bulletin*; Metalprices.com; London Metal Exchange; International Nickel Study Group.

TABLE 12. AVERAGE MONTHLY NICKEL PRICES, SETTLEMENT PRICE, 1996-2002

	1996	1997	1998	1999	2000	2001	2002
			(US $/t)				
January	7866	7047	5495	4272	8314	6999	6047
February	8219	7737	5390	4630	9658	6528	6033
March	8024	7899	5399	5015	10284	6138	6541
April	8047	7318	5397	5106	9731	6334	6962
May	8030	7485	5023	5403	10134	7064	6764
June	7712	7065	4479	5198	8415	6645	7123
July	7207	6836	4329	5704	8168	5940	7146
August	7057	6763	4084	6452	8010	5525	6720
September	7321	6507	4106	7031	8642	5030	6644
October	7034	6383	3875	7325	7683	4828	6808
November	6946	6142	4135	7953	7344	5082	7317
December	6584	5949	3881	8087	7319	5268	7197
			(converted to US$/lb)				
January	3.57	3.20	2.49	1.94	3.77	3.17	2.74
February	3.73	3.51	2.44	2.10	4.38	2.96	2.74
March	3.64	3.58	2.45	2.27	4.66	2.78	2.97
April	3.65	3.32	2.45	2.32	4.41	2.87	3.16
May	3.64	3.40	2.28	2.45	4.60	3.20	3.07
June	3.50	3.20	2.03	2.36	3.82	3.01	3.23
July	3.27	3.10	1.96	2.59	3.70	2.69	3.24
August	3.20	3.07	1.85	2.93	3.63	2.51	3.05
September	3.32	2.95	1.86	3.19	3.92	2.28	3.01
October	3.19	2.90	1.76	3.32	3.48	2.19	3.09
November	3.15	2.79	1.88	3.61	3.33	2.31	3.32
December	2.99	2.70	1.76	3.67	3.32	2.39	3.26

Source: INSG, various issues of *World Nickel Statistics* to April 2002.

Monthly Average LME Settlement Price of Nickel, 1996-2002



Sources: *Metal Bulletin*, Metalprices.com, London Metal Exchange; International Nickel Study Group.

TABLE 13. REFINED COBALT PRODUCTION, 1997-2002

Company	1997	1998	1999	2000	2001	2002
				(tonnes)		
PRODUCTION OF COMPANIES BELONGING TO THE COBALT DEVELOPMENT INSTITUTE						
OMG	5 000	5 250	6 200	7 700	8 100	8 200
Zambia (a)	3 949	5 011	3 946	(c) 2 316	(c) 2 789	4 344
Russia	3 800	3 700	4 000	4 100	4 600	4 200
Falconbridge	3 417	3 851	4 009	3 433	3 314	3 993
ICCI	2 250	2 640	2 770	2 855	2 943	3 065
Gécamines	2 808	4 490	(b) 5 180	4 320	3 199	2 149
QNI	617	1 395	1 539	1 520	1 818	1 863
China	1 200	1 200	1 200	1 200	1 470	1 842
Murrin Murrin			83	925	1 452	1 838
Mopani Copper				1 026	1 876	1 800
Inco	1 500	1 740	1 420	1 470	1 450	1 480
Umicore (1)	1 200	1 200	950	1 110	1 090	1 135
CTT	220	241	470	1 200	1 200	1 100
Brazil	266	364	630	792	889	960
Kasese			77	420	634	450
Sumitomo	263	329	221	311	350	354
India	110	120	120	206	250	270
South Africa	294	320	320	320	252	250
Bulong			79	192	203	200
Eramet	159	172	180	204	199	176
Subtotal	27 053	32 023	33 394	35 621	38 078	39 669
STOCKPILE DELIVERIES						
DLA	1 621	2 310	1 679	3 083	1 893	1 284
TOTAL COBALT AVAILABILITY						
Grand total	28 674	34 333	35 073	38 704	39 971	40 953

Source: *Cobalt News*, 02/2, April 2002, The Cobalt Development Institute. Table re-arranged in order of descending production for 2002; data reproduced with permission of The Cobalt Development Institute.

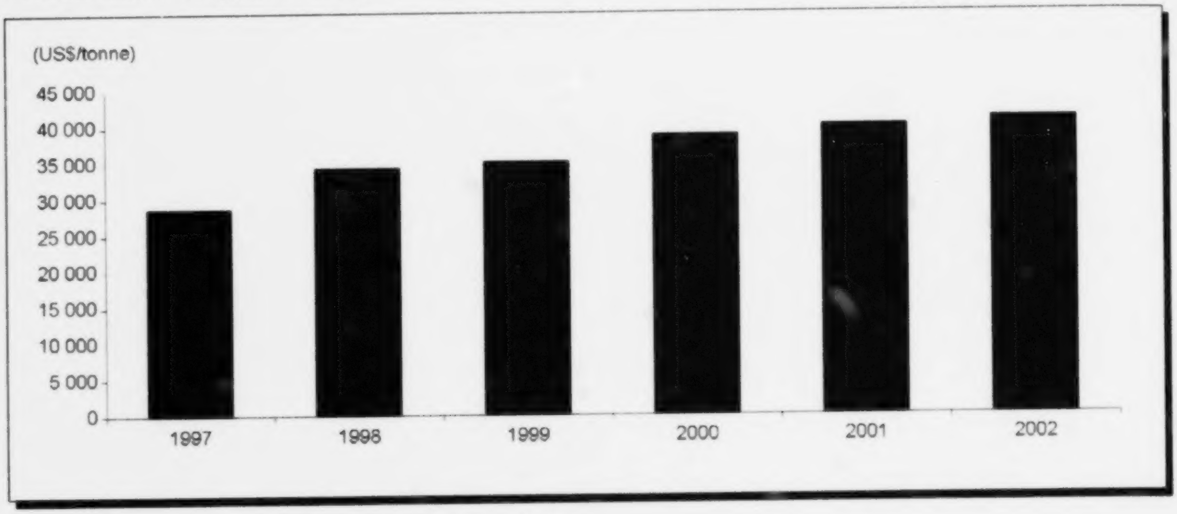
"Refined cobalt" includes:

All cobalt units whether in metal or chemicals that are derived from feed requiring further refining.
The following materials are NOT counted as feed: DLA or other stockpile releases, Russian output, production from Likasi, and lower-grade production from Moroccan mines.

(a) Zambian production includes ZCCM, RAMZ, and Avmin.
(b) Revised to include Central Mining Group.
(c) Chambishi Metals plc production only.
(e) Estimate.
(1) Union Minière SA changed its name to Umicore.

ICCI = International Cobalt Company Inc. (marketed by Sherritt International Corporation)
OMG = OM Group, Inc.
CTT = Cie. de Tifnout-Tiranimine
DLA = Defense Logistics Agency
ZCCM = Zambia Consolidated Copper Limited
RAMZ = Roan Antelope Mining Corporation
Gécamines = La Générale des Carrières et des Mines
Mopani Copper = Mopani Copper Mines plc (a JV comprising the Mufilira mine/smelter/refinery plus the Nkana mine and cobalt plant)

Cobalt Availability, 1997-2002



Source: Cobalt Development Institute data, *Cobalt News* 03/2
Note: Availability = company production plus DLA deliveries

Potash

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Potash is a generic term to describe a variety of mined minerals and manufactured chemicals, all containing the element potassium. Potash includes potassium chloride (sylvite), potassium-magnesium chloride (carnallite), potassium-magnesium sulphate (langbeinite), potassium sulphate and potassium nitrate. The dominant potash product is potassium chloride (KCl) or muriate of potash (MOP), a naturally occurring pink salty mineral of which Canada is the leading producer and exporter.

Ninety to ninety-five percent of the potash produced worldwide is used as agricultural fertilizer. Potash, along with nitrogen and phosphorus, are the three basic and important nutrients for plants. Potash supports plant growth and enhances the absorption of other nutrients. There is no substitute for potash. Smaller amounts are used for the manufacture of potassium-bearing chemicals, detergents, ceramics and pharmaceuticals, as water conditioners, or as an alternative to de-icing salt.

Potash is a limited resource that is only found in a few places in the world. Canada has the world's largest known potash resource, conservatively estimated at 56 billion t, or sufficient to mine for several thousands years at the current production level. The second largest deposit is located in Russia and Belarus. The brine of the Dead Sea in the Middle East is also very rich in potassium. The majority of potash is mined by conventional underground or solution mining. A portion of potash is also recovered from brines by solar evaporation.

CANADIAN DEVELOPMENTS

The Industry

Potash was discovered in Saskatchewan in the early 1940s. This deposit, the largest in the world, lies underneath the southern plains of Saskatchewan and western Manitoba and extends into northeastern Montana and North Dakota. Canadian potash mining began in the 1960s with the first potash mine opened in Saskatchewan in 1962. Subsequently, a solution mine opened in 1964 and more conventional mines joined production. By the mid-1980s, New Brunswick began producing potash. There are currently eleven underground mines in operation: nine conventional mines and two solution mines with a total work force of 3300.

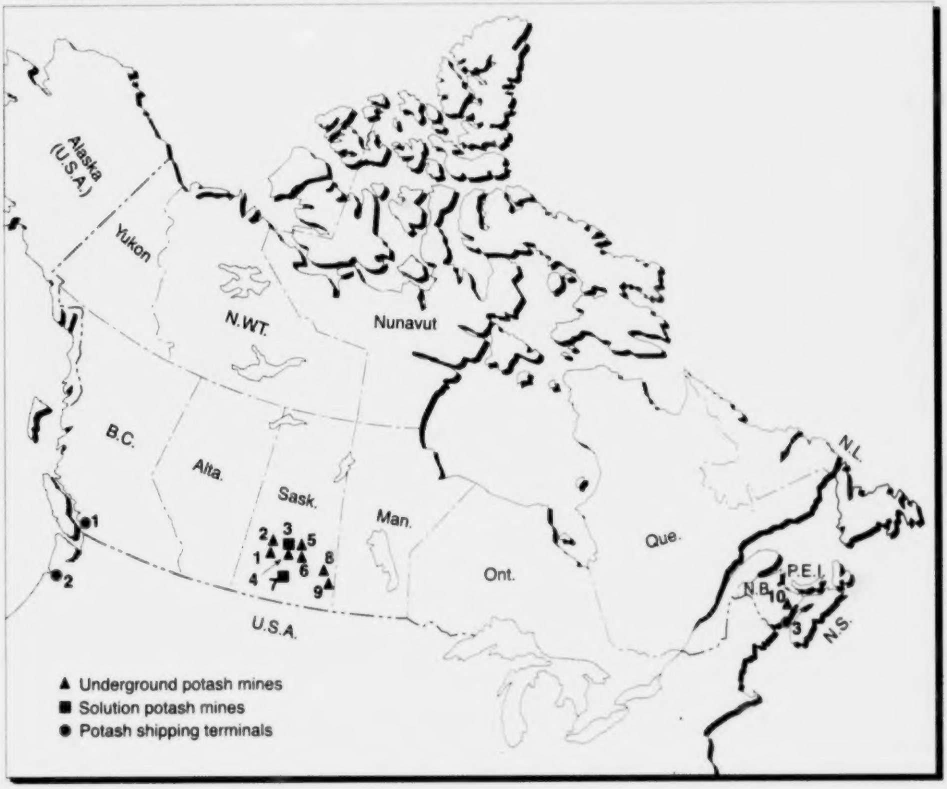
Potash Corporation of Saskatchewan Inc. (PCS Inc.), based in Saskatoon, Saskatchewan, is one of the world's largest publicly owned potash producers with six Canadian operations: Allan Division, Cory Division, Lanigan Division, New Brunswick Division, Patience Lake Division (a solution mine), and Rocanville Division. PCS Inc. also owns 25% of the reserves at Esterhazy, Saskatchewan, which are mined by IMC Esterhazy Canada Limited Partnership. PCS Inc. also has one potash operation in Chile.

IMC Global Inc. (IMC), whose head office is located in Lake Forest, Illinois, operates four mines in Saskatchewan: IMC Potash Belle Plaine (a solution mine), IMC Potash Colonsay Inc., and IMC Esterhazy Canada Limited Partnership (the K1 and K2 mines).

Agrium Inc., based in Calgary, Alberta, has one mine in Vanscoy, Saskatchewan.

Canpotex Ltd., owned by the three potash producers, Agrium, IMC and PCS Inc., is an exclusive offshore marketing company that markets Canadian potash to overseas markets such as Asia, Latin America, Europe, Australia

Figure 1
Location of Potash Mines in Canada and Shipping Terminals, 2002


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
N.L.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
4
5
6
7
8
9
10
1
2
3
▲ Underground potash mines
■ Solution potash mines
● Potash shipping terminals

Numbers refer to locations on map above.

UNDERGROUND POTASH MINES

1. Agrium Inc., Vanscoy, Saskatchewan
2. Potash Corporation of Saskatchewan Inc., Cory Division, Saskatoon, Saskatchewan
4. Potash Corporation of Saskatchewan Inc., Allan Division, Allan, Saskatchewan
5. IMC Potash Colonsay Inc., Colonsay, Saskatchewan
6. Potash Corporation of Saskatchewan Inc., Lanigan Division, Lanigan, Saskatchewan
8. IMC Esterhazy Canada Limited Partnership (K1 and K2 mines), Esterhazy, Saskatchewan
9. Potash Corporation of Saskatchewan Inc., Rocanville Division, Rocanville, Saskatchewan
10. Potash Corporation of Saskatchewan Inc., New Brunswick Division, Sussex, New Brunswick

SOLUTION MINING OPERATIONS

3. Potash Corporation of Saskatchewan Inc., Patience Lake Division, Patience Lake, Saskatchewan
7. IMC Potash Belle Plaine, Belle-Plaine, Saskatchewan

POTASH SHIPPING TERMINALS

1. Neptune Bulk Terminals, Vancouver, British Columbia
2. Portland Bulk Terminals, Portland, Oregon
3. Barrack Point Terminal, Saint John, New Brunswick

and Africa. Canpotex's sales are currently in the range of 5-6 Mt/y. A Singapore-based subsidiary, Canpotex International Pte. Ltd., is handling the company's marketing activities worldwide. It also has offices in Hong Kong and Tokyo. A corporate office in Saskatoon, Saskatchewan, is responsible for all operational functions, including inland transportation, ocean transportation, and terminals.

PRODUCTION

Canada produced 8.5 Mt K_2O[1] in 2002, accounting for 32% of world production of 26.5 Mt K_2O. All producers saw a moderate increase compared with the previous year's output of 8.2 Mt K_2O. However, Canada's production was still below the 2000 level of 9.2 Mt K_2O. This was mainly due to weather conditions limiting increases in fertilizer usage in the agricultural sector worldwide.

Saskatchewan, with 10 potash mines, produced 7.9 Mt K_2O in 2002, accounting for 95% of Canadian output and for about 30% of world production. The largest Canadian producer, PCS Inc., produced 6.4 Mt KCl, an increase of 5% from the previous year's 6.1 Mt. IMC's Canadian operations produced 5.9 Mt KCl, a 3% increase from the previous year. Agrium produced 1.5 Mt KCl, a 7% increase from the previous year.

New Brunswick's only potash mine, New Brunswick Division, located near Sussex, produced 600 000 t KCl in 2002, 76% of its capacity. PCS Inc. announced that it has discovered a potential significant, new high-grade ore zone adjacent to the existing mine for future development.

Manitoba's potash project, a joint venture between Entreprise minière et chimique of France and the Government of Manitoba, is still on hold. The Manitoba Potash Corporation holds the rights to the deposit in the Russell-Binscarth area adjacent to the Saskatchewan border. The deposit, discovered in the 1980s, contains an estimated 120 Mt of potash at a grade of 24.5% K_2O.

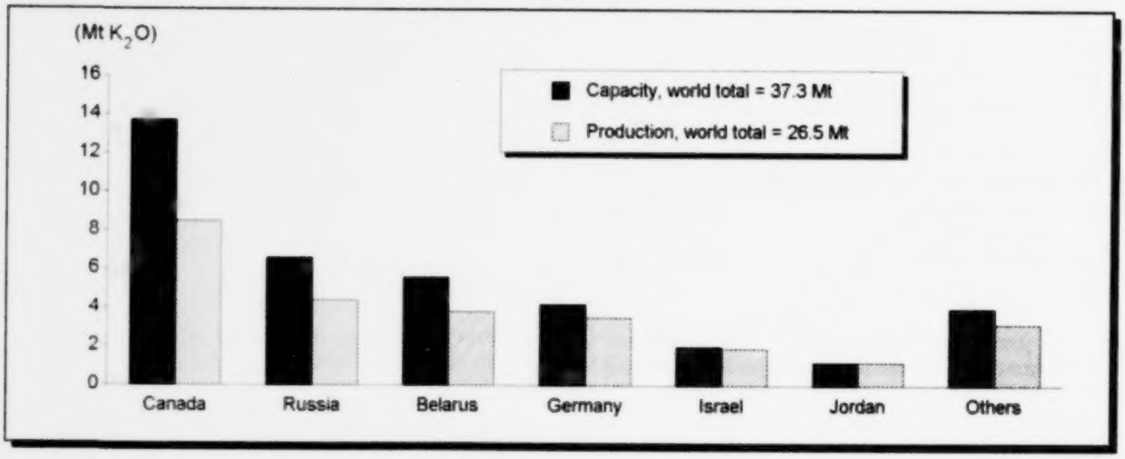
PRODUCTION CAPACITY AND USAGE

In 2002, Canada's production capacity was 22.7 Mt KCl, or 13.7 Mt K_2O equivalent, the world's largest, accounting for 37% of the total world capacity of 37.3 Mt K_2O. However, Canada's capacity usage rate was only at 62% in 2002, lower than the world average of 70%. This was mainly due to the lack of demand for fertilizer worldwide. PCS Inc. has an annual production capacity of 12.1 Mt KCl. Its utilization rate was only 53% in 2002. IMC's Canadian operations, with a capacity of 8.6 Mt/y KCl, used 69% in 2002. Agrium had a best capacity use rate of 75% for the year 2002 with an annual capacity of 2 Mt KCl.

EXPORTS

Canada remained the world's largest potash exporter for 2002. It exported 8.1 Mt K_2O, an increase of 4.3% from the 2001 level of 7.7 Mt K_2O. Exports to Asia, Latin America and Western Europe increased while exports to the United States remained constant. The United States remained Canada's largest export market, accounting for

Figure 2
Potash Capacity and Production by Country, 2002



Sources: Natural Resources Canada; International Fertilizer Industry Association.

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[1] Unless noted otherwise, statistical data refer to potassium oxide (1 t KCl = 0.6 t K_2O).

55% of total exports. Asia, including China, was Canada's second largest export market, accounting for 29%. Other destinations were Latin America (11%), Australia (3.5%) and Western Europe (1.5%). Most Canadian potash exports were shipped out of ocean terminals in Vancouver, British Columbia, and Portland, Oregon. PCS New Brunswick Division's production was shipped from the Barrick Point terminal in Saint John, New Brunswick.

WORLD DEVELOPMENTS

The 14 countries that produce potash had a total output of 26.5 Mt K_2O in 2002, a moderate increase of 4.4% from the previous year. Six countries (Canada, Russia, Belarus, Germany, Israel and Jordan) dominate production with 88% of the total.

Eastern Europe

Two countries of the former Soviet Union, Russia and Belarus, are the second and third leading potash producers in the world behind Canada. Ukraine also produces a small amount.

Russia produced 4.4 Mt K_2O in 2002, a 4.1% increase from 2001. Russia's Verkhnekamskoye deposit is situated in the Western Urals in the Perm region. JSC Uralkali and JSC Silvinit have a combined annual production capacity of 6.6 Mt K_2O and operated at 67% of their capacity in 2002.

Belarus produced 3.8 Mt K_2O in 2002, a 2.8% increase from the previous year. Belarus's Starobinskoye deposit is located near the city of Soligorsk. The only producer, Belaruskali, is state owned and has an annual capacity of 5.6 Mt K_2O. It operated at 68% of its capacity in 2002.

Western Europe

France produced 128 000 t in 2002, a 47.7% decrease from 2001. The reduction relates to the scheduled closing of Mines de Potasse d'Alsace (MDPA) in 2003.

Spain produced 406 600 t K_2O in 2002, down 13.6% from the previous year's 470 700 t. This was mainly due to poor weather conditions. The producer, IBERPOTASH S.A., is a subsidiary of the Dead Sea Works Ltd. (DSW) of Israel. IBERPOTASH supplies potash to European markets.

Germany's production slid by 2.8% to 3.45 Mt K_2O in 2002. The industry also had some changes in 2002. Kali und Salz GmbH merged with its parent company K+S Aktiengesellschaft (K+S Group) and was formed into two subsidiaries: K+S Kali GmbH and K+S Salz GmbH. K+S Kali GmbH is producing potash and magnesium. K+S Kali's new sylvinite project is scheduled to produce potash in the Werra-Ulster region between Hessen and Thüringen states in 2003.

The United Kingdom's production was stable in 2002 with output of 540 100 t K_2O. The only potash mine, Cleveland, was sold to DSW by Cleveland Potash Ltd. in May 2002.

North America

The **United States** produced about 1.2 Mt of potash in 2002. Production of potassium chloride was 862 600 t K_2O, a 6.7% increase from the 2001 level of 808 700 t. Most of the United States' production came from southeastern New Mexico where two companies operate three mines. One is operated by IMC Global Inc.'s (IMC) subsidiary, IMC Potash Carlsbad, which produces a variety of potash products. The other two are owned by Mississippi Chemical Corporation whose subsidiaries, Mississippi Potash East and Mississippi Potash West, produce MOP. In Michigan, IMC's subsidiary, IMC Potash Hersey, has a solution mine. In Utah, there are three companies producing potash with no significant output.

Latin America

Brazil is the third largest potash user in the world with average use of 3 Mt/y. Its only potash mine, the Taquari-Vassouras mine, belongs to Companhia Vale do Rio Doce (CVRD). It produced 363 800 t K_2O in 2002, operating at full capacity. The production was sold to the domestic market, accounting for 11% of the country's potash use. The remainder of the potash used comes from imports. CVRD is scheduled to increase production capacity to 510 000 t/y K_2O by 2005.

Chile's production increased 5% to 409 000 t K_2O in 2002. Chile's major producer, Sociedad Quimica y Minera de Chile S.A. (SQM), extracts potash using solar evaporation from brines of Salar de Atacama, an underground lake measuring 2900 km^2 in the desert of Atacama. The products derived from the Salar de Atacama brines include potassium chloride, potassium sulphate and other chemicals. SQM has a production capacity of 400 000 t/y K_2O. The company has been in talks to purchase Compania de Saltire y Yodo (Cosayach), which has a capacity of 120 000 t/y K_2O. PCS Yumbes has a capacity of 200 000 t/y K_2O.

Middle East

Israel's production reached 1.9 Mt K_2O in 2002, an increase of 8.1% from the previous year's 1.8 Mt. With the purchase of Cleveland Potash in May 2002, DSW now controls the potash production in Spain and the United Kingdom in addition to its own potash production, making it a player in the world potash industry.

Jordan's production was unchanged in 2002 at 1.17 Mt K_2O. Arab Potash Company (APC) is currently in the process of being privatized as part of a macroeconomic privatization program being conducted by the Government of Jordan. A 26% stake in APC is for sale. Four bidders in the running are PCS Inc. of Canada, K+S Group of Germany, Mitsubishi Corporation of Japan, and Sinochem of China. The transaction is expected to be closed in 2003.

Asia

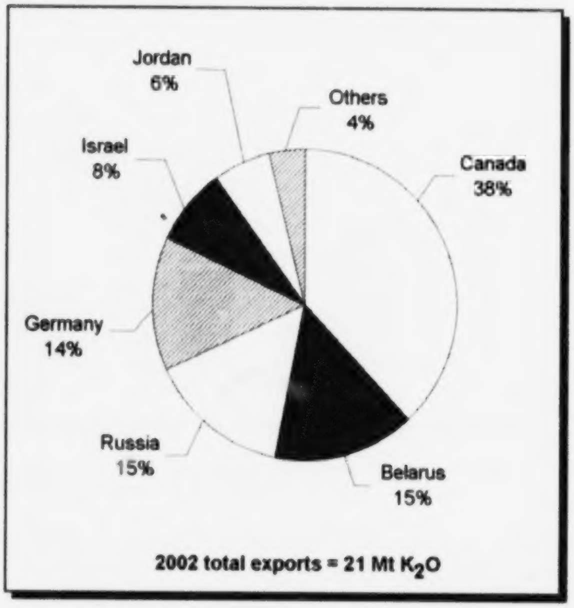
China joined the World Trade Organization (WTO) in December 2001, an important step to trade liberalization. China agreed to eliminate quantitative restrictions on fertilizer imports and to implement a tariff rate quota system. This action, however, has not had a significant impact on potash imports in 2002. China itself is a small potash producer with an output of 430 000 t K_2O in 2002, an increase of 8.9% from 395 000 t K_2O a year earlier. China's production comes from Qinghai Province where the Qaidam Basin is home to 97% of China's potash reserves and an ambitious 1-Mt project is under development. Phase I of the project is expected to add 300 000 t/y K_2O to Qinghai Yanhu Potash Fertilizer Ltd.'s capacity in 2003/04; the company will eventually become the largest potash producer in China. China's capacity is projected to reach 600 000 t/y K_2O in 2004 and 800 000 t/y K_2O in 2006.

Vancouver-based Asia Pacific Resources Ltd. (APR) seems to be a step closer in its effort to mine potash in **Thailand**. The company owns 90% of its subsidiary, Asia Pacific Potash Corporation (APPC), while the Government of Thailand owns the remaining 10%. APPC owns the Udon Thani South and North potash deposits in northeastern Thailand. A 1998 study concluded that a potash mine with output of 2 Mt/y and a 25- to 30-year mine life at the South deposit would be feasible. In August 2002, the Parliament of Thailand passed amendments to the *Minerals Act* that bring Thailand's legislation in line with international standards. The amendments permit mining at a depth greater than 100 metres below the surface without requiring the specific consent of the holder of the surface rights. On May 29, 2003, APPC applied to the Government of Thailand for a mining lease to mine potash in the Udon Thani South deposit. ASEAN Potash Mining Company Ltd.'s project at Bamnet Narong is still on hold pending the arrangement of financing.

TRADE

With many users but only a few producers, international trade is significant. In 2002, 21 Mt K_2O, or 80% of the total production, was traded internationally. Six major producing countries accounted for 96% of total potash exports as follows: Canada, 8.1 Mt K_2O; Belarus, 3.2 Mt K_2O; Russia, 3.2 Mt K_2O; Germany, 2.9 Mt K_2O; Israel 1.8 Mt K_2O; and Jordan, 1.1 Mt K_2O.

Figure 3
Percentage of Potash Exports by Country, 2002



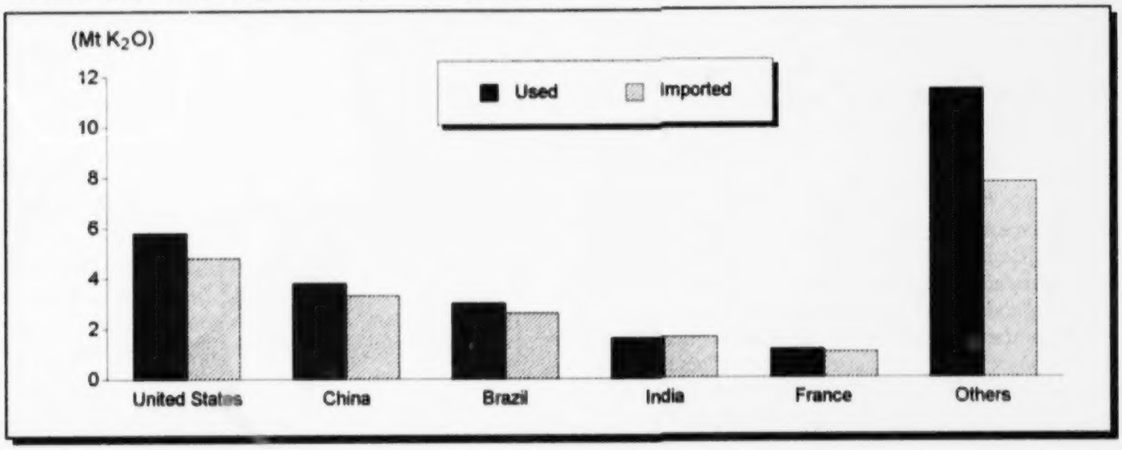
Sources: Natural Resources Canada; International Fertilizer Industry Association

The major potash users depend on imports. In 2002, the United States used 5.8 Mt K_2O of which 4.8 Mt was imported, including 4.4 Mt from Canada. China, the second largest potash user, consumed 3.8 Mt K_2O in 2002, of which 3.3 Mt was imported. Brazil used 3 Mt K_2O in 2002 of which 2.6 Mt was imports. India's potash use was 1.6 Mt K_2O, all from imports. France used 1.1 Mt K_2O in 2002, of which close to 1 Mt was from imports. These five countries accounted for 63% of world imports of potash in 2002.

PRICES

World potash market prices have been relatively stable for the past decade. Canpotex sells potash at prices f.o.b. Vancouver, c.i.f. foreign ports, or out of stockpiles in Asia. Quoted prices for KCl standard grade f.o.b. Vancouver were US$115-$130/t for 2000, US$105-$130/t for 2001, and US$110-$115/t for 2002. Prices for KCl granular grade f.o.b. Vancouver were steady at US$128-$132/t. Prices for KCl standard grade f.o.b. U.S. Gulf were US$120-$125/t and for KCl granular grade were US$125-$134/t. In Eastern Europe, the price for KCl standard grade f.o.b. Baltic was US$90-$110/t during 2000 and 2001 and US$93-$103/t during 2002. KCl granular grade f.o.b. Baltic prices were steady at US$94-$111/t. In the Middle East, prices for KCl standard grade f.o.b. the

Figure 4
Potash Used and Imported by Country, 2002



Source: Natural Resources Canada.

Middle East were US$105-$120/t during 2000, US$100-$120/t during 2001, and US$100-$120/t during 2002. In North America, Canadian producers also sell potash directly to U.S. customers. One producer's f.o.b. mine price for KCl standard grade averaged US$94/short ton in 2000, US$89/short ton in 2001 and US$88/short ton in 2002.

OUTLOOK

The primary driver for the fertilizer industry is the demand for foods, which in turn is driven by the population. The world population, estimated at 6.3 billion at the beginning of 2003, is expected to grow at a rate of 1.3% per year, reaching 6.9 billion by 2010 and 8 billion by 2020. The agricultural sector will have to meet the needs of this growing population.

Grains, as a major food source, rely heavily on fertilizer usage to increase production. In 2002, the world grain inventory was at the lowest level since 1976 and prompted grain prices to move upwards. The key indicators, wheat and corn prices, rose to US$3.38/bushel and US$2.32/bushel, respectively, in the first quarter of 2003 from the average 2002 prices of US$3.22/bushel and US$2.17/bushel. The potash industry worldwide viewed this as a driver for grain producers to raise production, which would translate into more demand for fertilizer.

Canadian potash producers are optimistic about the outlook for 2003 because of improved market conditions and rising demand in Asia and Latin America in 2002. In the first quarter of 2003, PCS Inc.'s sales increased 13% in the domestic market and 11% in offshore markets. IMC Global Inc. had a 7% sales increase. The producers predict the trend will continue for the rest of the year. The non-fertilizer use of potash is expected to remain unchanged. The Canadian potash industry welcomed the federal government's corporate tax rate reduction from 28% to 21% over a five-year period (Budget 2003).

In conclusion, the outlook is positive for production and sales increases in 2003, likely in the 2-3% range, with production reaching over 27 Mt K_2O. In the long term, growth in potash demand is expected from agricultural upgrading and expansion, particularly in developing countries.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 1, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
3104.20	Potassium chloride	Free	Free	Free	Free
3104.30	Potassium sulphate	Free	Free	Free	Free
3104.90.00.10	Magnesium-potassium sulphate	Free	Free	Free	Free
3104.90.00.90	Other	Free	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States,* 2003.

TABLE 1. CANADIAN POTASH PRODUCED, SHIPPED AND TRADED, 2001 AND 2002

		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION, Potassium chloride					
	Gross weight	13 356 517	. .	13 889 375	. .
	K_2O equivalent	8 181 265	. .	8 549 112	. .
SHIPMENTS					
	K_2O equivalent	8 236 662	1 617 433	8 188 701	1 597 763
IMPORTS, Fertilizer potash (1)					
3104.20	Potassium chloride				
	United States	4 969	769	6 290	907
	France	378	55	187	25
	Israel	–	–	95	17
	Germany	267	43	105	15
	Canada	6	1	50	6
	United Kingdom	9	1	27	5
	Spain	–	–	3	1
	Czech Republic	58	9	–	–
	Other countries	5	–	1	–
	Total	5 692	878	6 758	976
3104.30	Potassium sulphate				
	United States	1 198	435	6 055	2 182
	Belgium	63	34	337	183
	Denmark	27	14	44	25
	Japan	6	7	8	7
	Germany	67	41	4	4
	Australia	86	64	–	–
	China	34	7	–	–
	France	21	12	–	–
	Total	1 502	614	6 448	2 401
3104.90.00.10	Magnesium-potassium sulphate				
	United States	45 606	8 201	57 343	9 480
3104.90.00.90	Other potassic fertilizer				
	United States	29 996	7 792	23 540	5 684
	Australia	–	–	2 220	805
	Israel	127	71	365	212
	Chile	101	59	102	58

TABLE 1 (cont'd)

		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS, Fertilizer potash (1) (cont'd)					
	China	40	24	137	26
	Netherlands	7	2	6	3
	Norway	562	154	3	2
	Other countries	2	1	2	1
	Total	30 835	8 103	26 375	6 791
	Potash chemicals				
2815.20	Potassium hydroxide (caustic potash)	28 240	13 957	17 343	10 419
2834.21	Potassium nitrate	9 391	5 301	8 777	4 714
2835.24	Potassium phosphates	2 191	2 680	2 814	3 089
2836.40	Potassium carbonates	3 969	2 552	3 269	2 174
2839.20	Potassium silicates	2 748	1 522	1 576	1 250
EXPORTS, Fertilizer potash (1)					
3104.20	Potassium chlorides				
	United States	8 186 183	1 055 207	7 998 593	1 113 375
	China	1 479 906	331 759	1 655 043	377 214
	Brazil	918 250	165 663	1 032 860	188 918
	Japan	528 591	118 347	470 434	107 060
	Malaysia	357 517	80 013	459 506	104 848
	South Korea	342 682	77 069	370 987	84 514
	Australia	227 631	51 098	291 853	67 363
	India	193 431	43 365	218 890	49 683
	Taiwan	205 431	46 036	180 715	41 137
	New Zealand	160 200	35 914	171 719	39 254
	Thailand	150 478	33 875	134 552	30 306
	Indonesia	150 189	33 524	121 000	27 590
	Belgium	51 644	11 675	96 415	21 892
	Italy	73 161	16 589	87 869	20 006
	Costa Rica	59 372	13 214	64 215	14 652
	Vietnam	52 309	11 755	60 551	13 828
	Colombia	54 200	12 226	49 851	11 373
	Philippines	44 350	10 010	49 089	11 205
	Guatemala	46 329	9 772	37 086	7 725
	Ecuador	42 326	9 628	29 613	6 800
	Mexico	8 000	1 787	24 817	5 662
	Peru	5 000	1 103	24 223	5 380
	Chile	81 916	18 354	20 826	4 740
	Dominican Republic	–	–	34 100	4 649
	Cuba	33 000	4 163	35 200	4 446
	Spain	64 960	11 097	20 869	3 205
	Malawi	–	–	10 000	2 273
	Fiji	4 954	1 144	8 939	2 043
	Honduras	12 800	1 696	15 600	1 851
	Argentina	6 816	1 508	8 009	1 804
	Singapore	12 154	2 756	5 500	1 222
	Bangladesh	–	–	200	28
	Venezuela	16 243	2 062	–	–
	Jamaica	21	13	–	–
	Pakistan	18	4	–	–
	Total	13 570 062	2 212 426	13 789 124	2 376 046
3104.30	Potassium sulphate				
	United States	16 969	6 829	20 134	8 130
	Cuba	98	84	79	82
	Belgium	20	17	48	17
	Netherlands	12	39	–	–
	Total	17 099	6 969	20 261	8 229

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; (p) Preliminary.
(1) Countries are ranked in descending order of value for 2002.
Note: Numbers may not add to totals due to rounding.

TABLE 2. WORLD POTASH PRODUCTION, 1996-2002

	1996	1997	1998	1999	2000	2001	2002 (p)
				(000 t K_2O)			
NORTH AMERICA							
Canada	8 044	9 029	9 195	8 230	9 174	8 152	8 502
United States	1 390	1 400	1 300	1 200	1 300	1 200	1 200
EAST EUROPE							
Belarus	2 716	3 247	3 451	3 613	3 372	3 687	3 791
Russia	2 618	3 403	3 461	4 050	3 716	4 258	4 432
Ukraine	55	52	33	33	85	74	60
WESTERN EUROPE							
France	751	665	417	311	321	244	128
Germany	3 334	3 423	3 582	3 545	3 409	3 551	3 451
Spain	680	640	497	549	522	471	407
United Kingdom	618	565	608	495	601	532	540
MIDDLE EAST							
Israel	1 500	1 488	1 668	1 702	1 748	1 774	1 918
Jordan	1 059	849	916	1 080	1 162	1 177	1 174
LATIN AMERICA							
Brazil	234	280	327	337	340	345	364
Chile	179	235	280	312	330	390	409
ASIA							
China	150	186	168	260	275	395	430
Total world	23 328	25 462	25 903	25 717	26 355	26 250	26 806

Sources: Natural Resources Canada; International Fertilizer Industry Association; United States Geological Survey.
(p) Preliminary.

TABLE 3. POTASH SITUATION, 1991-2002

	1991	1992	1993	1994	1995	1996	1997	1998 (r)	1999 (r)	2000 (r)	2001 (r)	2002 (p)
						(000 tonnes K_2O)						
CANADA												
Capacity	12 045	12 180	12 180	12 235	13 220	13 310	13 390	13 400	13 405	13 460	13 460	13 700
Production	7 402	7 270	6 850	8 182	9 065	8 042	9 030	9 190	8 230	9 202	8 244	8 522
Capacity use (%)	61	60	56	67	69	60	67	69	61	68	60	62
Sales	7 056	7 025	6 863	8 517	8 635	7 970	9 510	8 267	8 290	9 033	8 183	8 332
Domestic	350	370	356	385	345	355	490	449	426	455	426	446
United States	3 610	3 945	4 048	4 560	4 495	4 335	5 295	4 328	4 246	4 570	4 410	4 421
Offshore	3 096	2 710	2 459	3 572	3 795	3 280	3 725	3 490	3 618	4 008	3 347	3 465
WORLD												
Capacity	37 068	36 594	35 512	35 624	36 299	36 529	36 836	36 490	36 663	36 840	36 960	37 320
Production	26 035	24 036	20 407	22 687	24 302	23 331	25 467	25 870	25 360	25 809	25 859	26 468
Capacity use (%)	70	66	57	64	67	64	69	71	69	70	70	71
Sales	24 175	23 175	20 835	23 620	23 375	22 490	25 745	24 259	24 589	25 320	25 176	26 177
Exports	17 765	17 623	15 026	19 768	18 522	17 076	20 397	19 175	19 755	20 410	20 210	21 099
Use	24 610	23 720	20 580	19 080	19 870	20 550	20 730	22 420	21 940	22 210	22 150	(e) 23 000
CANADA/WORLD												
Production (%)	38.4	30.2	33.6	36.1	37.3	34.5	35.5	35.5	32.5	35.7	31.9	32.2
Capacity (%)	32.5	33.3	34.3	34.3	36.4	36.4	36.4	36.7	36.6	36.5	36.4	36.8

Sources: Natural Resources Canada; International Fertilizer Industry Association.
(e) Estimate; (p) Preliminary; (r) Revised.
Note: Statistics are for potassium chloride only; other forms of potash are excluded.

Stone

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The volume of all types of stone shipped in Canada in 2002 was approximately 119 Mt based on preliminary figures. This amount is about 5% less than in 2001. However, the reported value of total shipments of all stone in 2002 was approximately $972 million, about 1.5% higher than the previous year. Shipments served a very wide range of uses related to dimension stone for construction and monuments; crushed stone for construction, chemical, metallurgical and miscellaneous uses; and pulverized stone for mineral fillers, agricultural uses and miscellaneous other uses (see Table 3).

Shipments of crushed stone (mainly chemical-grade limestone) for producing cement, as well as lime, are essentially accounted for in separate chapters entitled "Cement" and "Lime." Additional detailed information on regular aggregates (including crushed stone and sand and gravel), as well as on lightweight aggregates, is included in a separate chapter entitled "Mineral Aggregates." The lightweight aggregates included are: expanded shales/clays, perlite, vermiculite, pumice, and expanded ferrous slags or granules.

Dimension or ornamental stone relates to a variety of rock types that can be cut, shaped or simply selected for a broad range of construction/engineering, architectural or monumental requirements. The types of stone available are dependent on local geology, but mainly include granite, limestone, marble, sandstone and slate, as summarized in Tables 3 to 9 inclusive. The term "granite," as commercially applied, includes true granite, granodiorite, gneiss, and other medium- to coarse-grained igneous rocks. However, "black granite" may include anorthosite and other dark-coloured igneous rocks. Limestone and marble are often confused, marble being the metamorphosed equivalent of the former rock, and usually includes both dolomitic and calcitic varieties. As an industrial term, "marble" refers to recrystallized calcareous rock capable of taking a polish.

Developments in the dimension stone industry have continued to expand in Quebec, which accounts for about 75% of Canada's production of rough granite used for construction (Figure 3). However, new quarries have also been developed during recent years in other provinces, along with additional fabricating capacity to produce finished products for both domestic and export markets. In both British Columbia and Newfoundland and Labrador, there has been increased output of rough granite, finished granite, and rough and finished slate products; in Ontario, there has been increased output of a broad range of rough finished stone products. Some details by province on the types of dimension stone produced are included in catalogue no. 26-226-XIB, *Non-Metallic Mineral Mining and Quarrying* (see Table 10), which is available on the Internet at www.statcan.ca/english/freepub/26-226-XIB/free.htm.

Major trends in exports of rough dimension stone and relatively high value-added finished stone products from both domestic rough stone blocks and imported blocks, during the period 1998-2002, are summarized as follows: 1) in Quebec, there has been a combined increase of 38% in the value of exports of rough granite and worked granite, along with finished slate, to about $105 million in 2002; 2) in Ontario, there has been a 60% increase in the combined value of exports of rough and finished products mainly relating to granite, slate, marble and other calcareous stone to about $20 million; and 3) in British Columbia there has been a doubling in the value of exports of rough and finished dimension stone products to about $17 million. Total exports of all rough stone and finished stone products (excluding crushed stone products) amounted to about $190 million in 2002 (Table 1).

It is expected that growth in the use of dimension stone in Canada will be maintained in 2003 based mainly on continued strength in commercial construction, including office buildings. Similarly, exports of rough stone and fabricated stone products are expected to remain firm despite growing weakness during early 2003 in public construction in the United States. Good-quality rough slate and worked slate products continue to be of growing importance in world markets.

Additional information on the Canadian stone industry can be found at provincial government web sites relating to natural resources (links to these are available on Natural Resources Canada's web site at www.nrcan.gc.ca/mms/lien/ptd_e.htm).

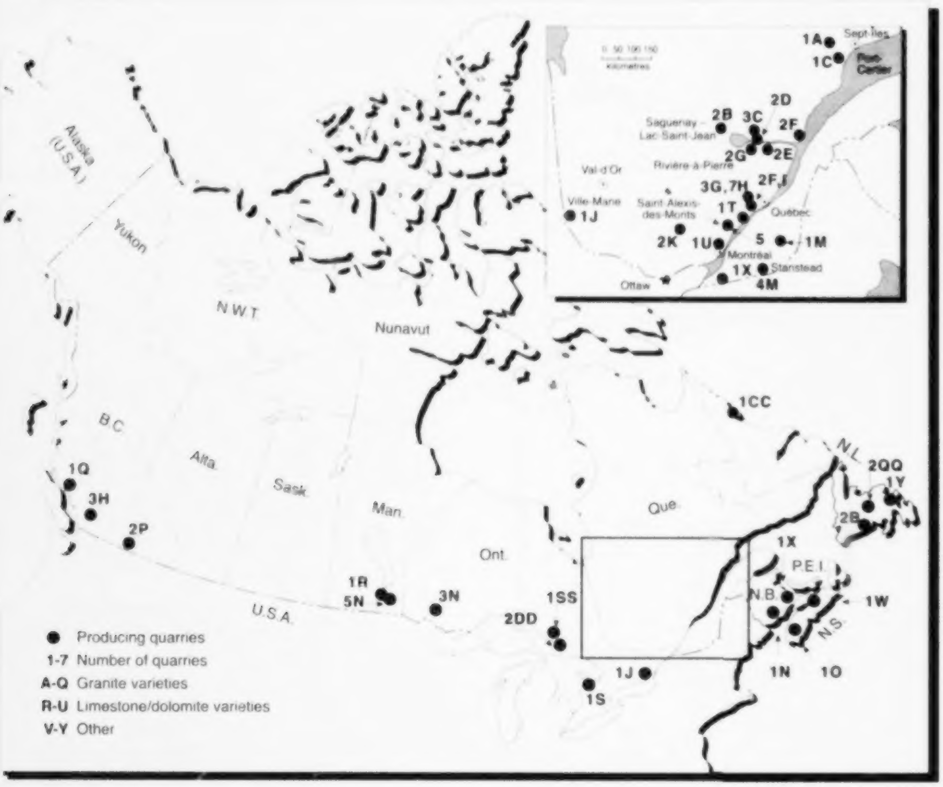
In addition, commercial names relating to many rough and finished stone products can be found at the Canadian Stone Association's (CSA) web site at www.stone.ca.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of February 1, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

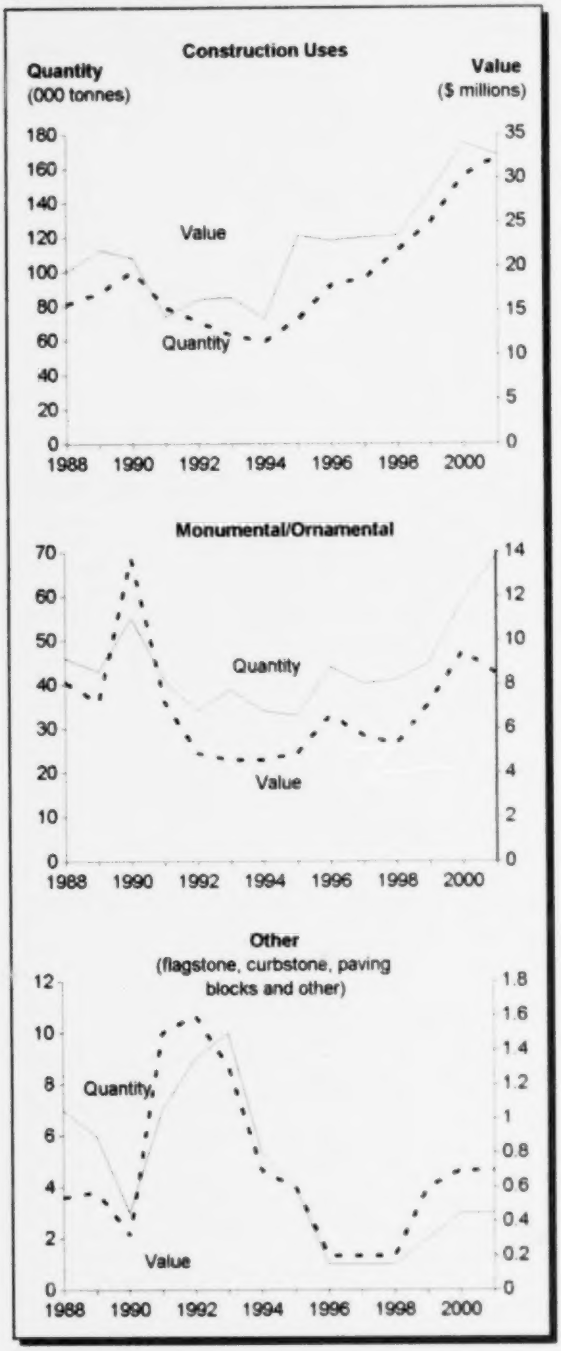
Figure 1
Canada, Architectural and Monumental/Ornamental Stone-Producing Centres, 2001


0 50 100 150
kilometres
1A
Sept-Îles
1C
Port-Cartier
2D
2B
3C
2F
Saguenay – Lac-Saint-Jean
2G
2E
Val-d'Or
Rivière-à-Pierre
3G,7H
2F,J
Ville-Marie
1J
Saint-Alexis-des-Monts
1T
Québec
2K
1U
5
1M
Montréal
1X
Stanstead
4M
Ottawa
Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
1CC
B.C.
Alta.
Sask.
Man.
Ont.
Que.
NL
2QQ
1Y
2B
1X
P.E.I.
N.B.
1W
N.S.
1Q
3H
2P
1R
5N
3N
1SS
2DD
U.S.A.
1J
1S
1N
1O
● Producing quarries
1-7 Number of quarries
A-Q Granite varieties
R-U Limestone/dolomite varieties
V-Y Other

A	Fine-grained pinkish-grey banded gneiss
B	Medium-grained pink granite
C	Coarse-grained black anorthosite
CC	Medium-grained "Reflect blue" anorthosite
D	Medium-grained black gabbroic anorthosite
DD	Blue-grey, and black and white anorthosite
E	Medium-grained pinkish-grey quartz monzonite
F	Fine-grained pink granitic gneiss
G	Coarse-grained green charnockite
H	Coarse-grained pink-grey or brown-grey granite
I	Medium-grained grey dioritic gneiss
J	Medium-grained red granite
K	Fine-grained pink aplite
L	Coarse-grained brown or red quartz monzonite
M	Medium-grained grey granite
N	Medium-grained pink, brown or gold granites
O	Fine-grained blue-grey granite
P	Coarse coral pink granite
Q	Medium-grained blue-grey granite
QQ	Medium-grained gabbro
R	Light-coloured mottled dolomitic limestone (Tyndall)
S	Fine-medium crystalline blue-grey to buff marble/dolostone (Arriscraft)
SS	Fine-grained, multicoloured pre-Cambrian marble
T	Medium-grained light brownish-grey limestone (Deschambault)
U	Medium-grained blue-grey limestone (Chazy)
V	Medium-grained olive sandstone
W	Fine-medium-grained olive-brown and blue-grey sandstone
X	Fine-medium-grained white to buff sandstone (Potsdam)
Y	Very fine-grained varicoloured slate

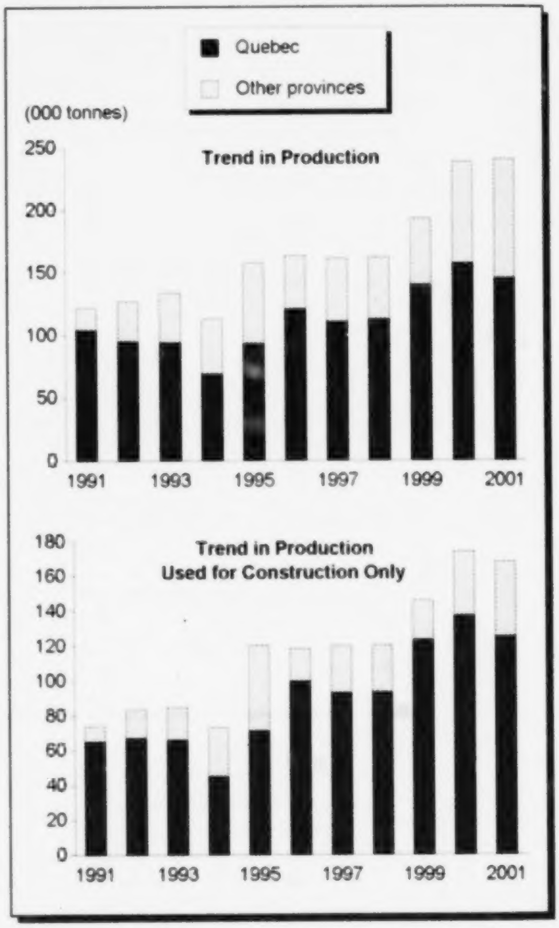
Source: Mainly provincial departments of Mines and Energy.

Figure 2
Canada, Production of Rough Granite (Sold and Used by Producers), 1988-2001



Sources: Natural Resources Canada; Statistics Canada.

Figure 3
Canada, Trends in Production of Rough Dimensional Granite for Construction, Monumental/Ornamental and Other Uses, 1991-2001



Sources: Natural Resources Canada; Quebec Ministry of Natural Resources.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2514.00	Slate, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
2514.00.10	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
2514.00.90	Other	Free	Free	Free	Free
25.15	Marble, travertine, ecaussine and other calcareous monumental or building stone of an apparent specific gravity of 2.5 or more, and alabaster, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
	Marble and travertine:				
2515.11.00	Crude or roughly trimmed	Free	Free	Free	Free
2515.12.00	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	Free	Free	Free	Free
2515.20	Ecaussine and other calcareous monumental or building stone; alabaster				
2515.20.10	Crude or roughly trimmed	Free	Free	Free	Free
2515.20.20	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
25.16	Granite, porphyry, basalt, sandstone and other monumental or building stone, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
	Granite:				
2516.11.00	Crude or roughly trimmed	Free	Free	Free	Free
2516.12	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	Free-3.5%	Free	Free	Free
	Sandstone:				
2516.21.00	Crude or roughly trimmed	Free	Free	Free	Free
2516.22.00	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
2516.90	Other monumental or building stone				
2516.90.10	Crude or roughly trimmed	Free	Free	Free	Free
2516.90.20	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
25.17	Pebbles, gravel, broken or crushed stone, of a kind commonly used for concrete aggregates, for road metalling or for railway or other ballast, shingle and flint, whether or not heat-treated; macadam of slag, dross or similar industrial waste, whether or not incorporating the materials cited in the first part of the heading; tarred macadam, granules, chippings and powder, of stones of heading nos. 25.15 or 25.16, whether or not heat-treated				
2517.10.00	Pebbles, gravel, broken or crushed stone, of a kind commonly used for concrete aggregates for road metalling or for railway or other ballast, shingle and flint, whether or not heat-treated	Free	Free	Free	Free

TARIFFS (cont'd)

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2517.20.00	Macadam of slag, dross or similar industrial waste, whether or not incorporating the materials cited in subheading no. 2517.10	Free	Free	Free	Free
2517.30.00	Tarred macadam	6.5%	Free	Free	Free
	Granules, chippings and powder, of stones of heading nos. 25.15 or 25.16, whether or not heat-treated:				
2517.41.00	Of marble	Free	Free	Free	Free
2517.49	Other				
2517.49.10	Limestone, roofing granules	Free	Free	Free	Free
2517.49.90	Other	Free	Free	Free	Free
6801.00	Setts, curbstones and flagstones of natural stone (except slate)	3.5%	Free	Free	Free
68.02	Worked monumental or building stone (except slate) and articles thereof, other than goods of heading no. 68.01; mosaic cubes and the like, of natural stone (including slate), whether or not on a backing; artificially coloured granules, chippings and powder, of natural stone (including slate)				
6802.10	Tiles, cubes and similar articles, whether or not rectangular (including square), the largest surface area of which is capable of being enclosed in a square the side of which is less than 7 cm; artificially coloured granules, chippings and powder				
6802.10.10	Artificially coloured roofing granules	Free	Free	Free	Free
6802.10.90	Other	8%	5%	Free	Free
	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface:				
6802.21.00	Marble, travertine and alabaster	3.5%	Free	Free	Free
6802.22.00	Other calcareous stone	5%	Free	Free	Free
6802.23.00	Granite	3.5%	Free	Free	Free
6802.29.00	Other stone	5%	Free	Free	Free
	Other:				
6802.91.00	Marble, travertine and alabaster	6%	Free	Free	Free
6802.92.00	Other calcareous stone	6.5%	3%	Free	Free
6802.93.00	Granite	6.5%	6.5%	Free	Free
6802.99.00	Other stone	6.5%	6.5%	Free	Free
6803.00	Worked slate and articles of slate or of agglomerated slate				
6803.00.10	Roofing slate; slate for use in the manufacture of billiard tables	Free	Free	Free	Free
6803.00.90	Other	6.5%	6.5%	Free	Free
68.04	Millstones, grindstones, grinding wheels and the like, without frameworks, for grinding, sharpening, polishing, trueing or cutting, hand sharpening or polishing stones, and parts thereof, of natural stone, of agglomerated natural or artificial abrasives, or of ceramics, with or without parts of other				
6804.10.00	Millstones and grindstones for milling, grinding or pulping	6.5%	Free	Free	Free
6804.23.00	Of natural stone	6.5%	Free	Free	Free

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003.

TABLE 1. CANADA, STONE EXPORTS AND IMPORTS, 2000-02

Item No.		2000		2001		2002 (p)	
		(t)	($000)	(t)	($000)	(t)	($000)
EXPORTS							
2514.00	Slate: Whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	271	137	357	252	299	138
2515.11	Marble and travertine: Crude or roughly trimmed; other calcareous stone	4	4	5	14	30	60
2515.12	Marble and travertine: Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape; other calcareous stone	633	440	604	358	191	142
		(cubic metres)		**(cubic metres)**		**(cubic metres)**	
2516.11	Granite: Crude or roughly trimmed	28 260	13 163	31 569	13 195	41 229	11 168
		(tonnes)		**(tonnes)**		**(tonnes)**	
2516.12	Granite: Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	19 379	6 248	25 592	6 832	15 164	5 414
		(cubic metres)		**(cubic metres)**		**(cubic metres)**	
2516.21	Sandstone: Crude or roughly trimmed	15	13	45	91	47	80
		(tonnes)		**(tonnes)**		**(tonnes)**	
2516.22	Sandstone: Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	118	56	338	194	36	70
2516.90	Other monumental or building stone	3 151	806	3 176	1067	7 258	2 993
2517.10	Pebbles and gravel of a kind commonly used for concrete aggregates, for road metalling or for railway or other ballast, shingle and flint, whether or not heat-treated	3 778 004	35 450	4 911 787	49 130	5 099 794	62 766
2517.41	Granules, chippings and powder, of stones of heading No. 25.15 or 25.16, whether or not heat-treated: Of marble	347 873	56 015	49 078	8 983	32 365	6 864
2517.49	Granules, chippings and powder, of stones of heading No. 25.15 or 25.16, whether or not heat-treated: Other	100 853	6 103	35 520	1 269	4 722	446
6801.00	Setts, curbstones and flagstones, of natural stone (except slate)	. .	1 631	. .	2 496	. .	3 543
6802.10	Tiles, cubes and similar articles, whether or not rectanglular	. .	35 739	. .	41 932	. .	19 930
6802.21	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Marble, travertine and alabaster	. .	39	. .	687	. .	636
6802.22	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Other calcareous stone	..	73	..	647	..	3310
6802.23	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Granite	. .	1 862	. .	4 145	. .	2 145
6802.29	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Other stone	. .	941	. .	1169	. .	958
6802.91	Other: Marble, travertine and alabaster	. .	1 403	. .	2 051	. .	3 137
6802.92	Other: Other calcareous stone	. .	4 196	. .	8 948	. .	7 735
6802.93.10	Other: Granite: Monuments, bases and markers, finished	14 269	26 407	10 303	20 573	12 938	21 800
6802.93.90	Other: Granite: Other	25 605	38 713	44 950	43 650	28 590	49 048
6802.99	Other: Other stone	. .	31 596	. .	40 087	. .	40 887
6803.00	Worked slate and articles of slate or of agglomerated slate	. .	11 148	. .	6 371	. .	15 808

TABLE 1 (cont'd)

Item No.		2000		2001		2002 (p)	
		(t)	($000)	(t)	($000)	(t)	($000)
EXPORTS (cont'd)							
6804.10	Millstones and grindstones for milling, grinding or pulping	..	4 521	..	5 233	..	5 154
6804.23	Other millstones, grindstones, grinding wheels and the like: Of natural stone	..	538	..	436	..	140
	Total exports	..	277 242	..	259 812	..	264 372
IMPORTS							
2514.00	Slate: Whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	4 147	1 973	6 371	3 399	8 645	4 532
2515.11	Marble and travertine: Crude or roughly trimmed; other calcareous stone	1 628	810	2 157	927	2 585	1494
2515.12	Marble and travertine: Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	1 433	979	1 278	1060	2 664	2 860
2516.11	Granite: Crude or roughly trimmed.	62 059	18 351	81 433	24 144	79 639	25 231
2516.12	Granite: Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3 982	3 510	4 034	3 719	4 557	3 770
2516.21	Sandstone: Crude or roughly trimmed	6 002	625	11 847	1573	13 263	1 604
2516.22	Sandstone: Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	5 268	1 749	5 010	1 758	4 998	1 743
2516.90	Other monumental or building stone	9 909	3 118	8 539	3 520	9 365	3 775
2517.10	Pebbles and gravel of a kind commonly used for concrete aggregates, for road metalling or for railway or other ballast, shingle and flint, whether or not heat-treated	3 127 278	17 314	3 219 677	17 304	3 372 987	19 911
2517.41	Granules, chippings and powder, of stones of heading No. 25.15 or 25.16, whether or not heat-treated: Of marble	59 201	10 435	73 417	15 562	82 869	16 962
2517.49	Granules, chippings and powder, of stones of heading No. 25.15 or 25.16, whether or not heat-treated: Other	30 058	1 730	27 859	1 691	27 342	2 340
6801.00	Setts, curbstones and flagstones, of natural stone (except slate)	..	438	..	713	..	903
6802.10	Tiles, cubes and similar articles, whether or not rectanglular	..	795	..	554	..	714
6802.21	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Marble, travertine and alabaster	..	11 136	..	11 889	..	12 700
6802.22	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Other calcareous stone	..	248	..	637	..	413
6802.23.00.10	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Granite. Building stone	5 550	6 692	5 692	7 082	5 843	7 879
6802.23.00.20	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Granite. Monumental	643	772	695	759	1470	1525
6802.23.00.90	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface: Granite. Monumental	10 493	14 698	11 089	16 559	15 751	22 483
6802.29	Other stone	..	2 381	..	2 651	..	2 430
6802.91	Other: Marble, travertine and alabaster	..	20 531	..	25 936	..	29 949
6802.92	Other: Other calcareous stone	..	3 024	..	5 347	..	2 263
6802.93.00.10	Other: Granite. Monumental or building stone	1 336	2 004	1 388	2 409	1 751	3 047
6802.93.00.20	Other: Granite. Monuments, bases and markers, finished	2 282	3 622	3 606	5 509	3 562	4 684
6802.93.00.90	Other: Granite. Other	5 191	7 982	6 238	9 613	7 263	9 724
6802.99	Other: Other stone	..	3 130	..	3 123	..	3 269

TABLE 1 (cont'd)

Item No.		2000		2001		2002 (p)	
		(t)	($000)	(t)	($000)	(t)	($000)
IMPORTS (cont'd)							
6803.00	Worked slate and articles of slate or of agglomerated slate	. .	8 010	. .	8 165	. .	7 930
6804.10	Millstones and grindstones for milling, grinding or pulping	. .	2 494	. .	2 607	. .	3 023
6804.23	Other millstones, grindstones, grinding wheels and the like: Of natural stone	. .	842	. .	1106	. .	1 157
	Total imports	. .	(r) 149 393	. .	179 316	. .	198 315

Source: Statistics Canada.
. . Not available or not applicable; n.e.s. Not elsewhere specified; (p) Preliminary; (r) Revised.

TABLE 2. CANADA, STONE PRODUCTION BY TYPE,(1) 1985, 1990 AND 2000-02

	1985		1990		2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
Granite	17 219	95 424	19 524	147 048	22 054	204 794	27 005	233 463	25 002	223 874
Limestone	77 874	317 862	86 519	470 649	88 941	534 596	89 845	578 246	86 739	597 050
Marble	571	13 966	771	19 555	1 370	93 217	1 284	93 764	1 325	100 911
Sandstone	3 011	15 310	2 975	20 534	4 910	34 150	4 649	33 984	4 247	31 537
Shale (2)	1 561	3 059	1 566	5 169	948	14 504	1 976	17 590	1 800	18 451
Total	100 236	445 622	111 355	663 254	118 222	881 260	124 758	957 048	119 113	971 822

Source: Natural Resources Canada.
(p) Preliminary.
(1) Data exclude stone used in the Canadian cement, lime and clay industries. (2) May include slate.
Note: Numbers may not add to totals due to rounding.

TABLE 3. CANADA, STONE PRODUCTION, 2000-02

Item No.	2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY (1)						
Newfoundland and Labrador	4 505	27 859	4 390	31 522	4 625	35 788
Nova Scotia	8 379	51 246	8 749	59 028	8 246	55 570
New Brunswick	3 294	19 429	4 204	20 073	3 178	19 074
Quebec	31 550	229 984	36 436	266 536	35 363	256 549
Ontario	58 704	474 155	57 969	501 956	55 633	514 805
Manitoba	4 007	19 668	3 744	17 837	3 744	18 558
Saskatchewan	x	x	x	x	x	x
Alberta	x	x	476	5 599	335	4 445
British Columbia	6 636	49 172	7 212	51 412	7 171	60 179
Northwest Territories	186	2 952	1 577	3 085	818	6 854
Total	118 222	881 260	124 758	957 048	119 113	971 822
BY USE (2)						
Stone (Dimension)						
Dimension stone						
Rough	360	50 388	363	53 760	. .	. .
Monumental and ornamental stone (n.f.)	111	10 598	106	9 323	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	105	16 311	110	16 136	. .	. .
Total dimension stone	576	77 297	579	79 219	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	21 830	131 073	21 502	148 723	. .	. .
Asphalt aggregate	11 509	72 753	12 152	79 648	. .	. .
Road metal	36 478	192 907	37 792	203 984	. .	. .
Railroad ballast (includes traprock)	1 681	14 375	1 475	12 824	. .	. .
Other uses	36 061	201 603	41 693	236 138	. .	. .
Chemical and metallurgical						
Cement plants, Canada	14 776	44 570	15 548	50 300	. .	. .
Cement plants, foreign	539	2 273	454	2 051	. .	. .
Flux in iron and steel furnaces	680	6 279	477	3 275	. .	. .
Flux in nonferrous smelters	100	1 519	145	1 969	. .	. .
Glass factories	51	738	44	591	. .	. .
Lime plants, Canada	3 184	19 513	2 970	17 279	. .	. .
Lime plants, foreign	1 437	8 586	1 825	13 328	. .	. .
Pulp and paper mills	118	1 271	69	642	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	1 763	12 777	1 767	10 657	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	2	68	2	60	. .	. .
Roofing granules	873	37 348	854	40 426	. .	. .
Poultry grit	173	1 427	232	2 520	. .	. .
Stucco dash	23	3 985	20	4 452	. .	. .
Terrazzo chips	9	666	6	586	. .	. .
Rock wool	25	431	30	430	. .	. .
Rubble and riprap	1 257	4 476	867	3 650	. .	. .
Other uses	1 562	8 245	1 591	10 313	. .	. .
Pulverized stone						
Whiting	44	3 971	37	3 258	. .	. .
Asphalt filler	200	383	126	125	. .	. .
Dusting coal mines	1	51	1	89	. .	. .
Agricultural purposes and fertilizer plants	1 113	18 500	847	13 170	. .	. .
Other uses	1 064	82 428	1 259	88 782	. .	. .
Total crushed stone	136 554	872 196	143 783	949 271	. .	. .
Total all stone	137 130	949 493	144 362	1 028 490	. .	. .

Source: Natural Resources Canada.

– Nil; . . Not available; n.f. Not finished or dressed; (p) Preliminary; x Confidential.

(1) Data exclude stone used in the Canadian cement, lime and clay industries. (2) Data include stone used in the Canadian cement, lime and clay industries.

Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, LIMESTONE PRODUCTION, 2000-02

	2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY (1)						
Newfoundland and Labrador	2 259	14 580	1 726	12 880	2 435	19 307
Nova Scotia	200	x	236	x	208	x
New Brunswick	652	x	619	x	583	x
Quebec	22 886	131 367	26 541	161 053	24 567	146 326
Ontario	55 355	333 780	53 834	352 504	51 657	369 078
Manitoba	3 548	15 136	3 196	14 477	3 202	14 498
Saskatchewan	x	x	–	–	–	–
Alberta	x	x	463	3 395	320	2 158
British Columbia	3 025	25 212	3 179	24 633	3 569	33 580
Northwest Territories	69	x	50	x	198	x
Total	88 941	534 596	89 845	578 246	86 739	597 050
BY USE (2)						
Stone (Dimension)						
Dimension stone						
Rough	81	7 214	80	6 904	. .	. .
Monumental and ornamental stone (n.f.)	45	811	35	680	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	69	6 679	70	6 343	. .	. .
Total dimension stone	195	14 704	186	13 928	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	18 569	109 303	18 162	125 135	. .	. .
Asphalt aggregate	6 761	39 980	6 873	42 730	. .	. .
Road metal	29 433	157 038	28 029	155 602	. .	. .
Railroad ballast (includes traprock)	86	475	79	457	. .	. .
Other uses	27 281	148 938	30 455	172 514	. .	. .
Chemical and metallurgical						
Cement plants, Canada	13 943	41 244	14 827	47 457	. .	. .
Cement plants, foreign	482	2 014	418	1 893	. .	. .
Flux in iron and steel furnaces	680	6 279	477	3 275	. .	. .
Flux in nonferrous smelters	39	684	94	1 642	. .	. .
Glass factories	51	738	44	591	. .	. .
Lime plants, Canada	3 184	19 513	2 970	17 279	. .	. .
Lime plants, foreign	1 437	8 586	1 825	13 328	. .	. .
Pulp and paper mills	118	1 271	69	642	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	928	9 710	680	6 794	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	–	–	–	–	. .	. .
Roofing granules	103	623	126	982	. .	. .
Poultry grit	172	1 351	230	2 399	. .	. .
Stucco dash	22	3 822	19	4 269	. .	. .
Rock wool	2	11	3	17	. .	. .
Rubble and riprap	725	2 341	326	1 796	. .	. .
Other uses	752	6 013	665	8 946	. .	. .
Pulverized stone						
Whiting	44	3 971	37	3 258	. .	. .
Asphalt filler	68	299	11	61	. .	. .
Dusting, coal mines	1	51	1	89	. .	. .
Agricultural purposes and fertilizer plants	1 046	16 152	763	10 188	. .	. .
Other uses	78	1 477	272	7 711	. .	. .
Total crushed stone	106 007	581 883	107 456	629 055	. .	. .
Total all stone	106 202	596 587	107 642	642 982	. .	. .

Source: Natural Resources Canada.

– Nil; . . Not available; n.f. Not finished or dressed; (p) Preliminary; x Confidential.

(1) Data exclude stone used in the Canadian cement and lime industries. (2) Data include stone used in the Canadian cement and lime industries.

Notes: Includes dolomite/dolostone. Numbers may not add to totals due to rounding.

TABLE 5. CANADA, MARBLE PRODUCTION,[1] 2000-02

	2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE						
Quebec	612	x	549	x	581	x
Ontario	757	x	734	x	744	x
British Columbia	1	x	–	–	–	–
Total	1 370	93 217	1 284	93 764	1 325	100 911
BY USE						
Stone (Dimension)						
Dimension stone						
Rough	19	1 071	22	1 107	. .	. .
Monumental and ornamental stone (n.f.)	1	104	–	–	. .	. .
Other (flagstone, curbstone, paving, blocks, etc.)	11	1 738	11	2 119	. .	. .
Total dimension stone	31	2 913	33	3 226	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	202	2 134	167	1 851	. .	. .
Asphalt aggregate	3	18	8	46	. .	. .
Road metal	62	295	18	84	. .	. .
Other uses	124	3 112	125	3 154	. .	. .
Chemical process stone						
Flux in nonferrous smelters	4	131	. . .	10	. .	. .
Glass factories	–	–	–	–	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	2	60	2	60	. .	. .
Roofing granules	28	756	46	1 527	. .	. .
Poultry grit	. . .	3	1	22	. .	. .
Stucco dash	1	23	1	150	. .	. .
Terrazzo chips	7	303	6	586	. .	. .
Rock wool	–	–	–	–	. .	. .
Rubble and riprap	–	–	–	–	. .	. .
Other uses	11	717	4	323	. .	. .
Pulverized stone						
Agricultural purposes and fertilizer plants	67	2 349	84	2 982	. .	. .
Other uses	802	79 742	791	79 744	. .	. .
Total crushed stone	1 317	90 113	1 251	90 538	. .	. .
Total all stone	1 348	93 026	1 284	93 764	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; (p) Preliminary; x Confidential.
(1) Marble refers to a commercial definition that may also include limestone, travertine and greenstone (serpentinite or amphibole).
Note: Numbers may not add to totals due to rounding.

TABLE 6. CANADA, GRANITE PRODUCTION, 2000-02

	2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY						
Newfoundland and Labrador	1 053	8 753	1 431	12 301	1 322	10 611
Nova Scotia	6 736	40 356	7 040	46 803	6 572	43 087
New Brunswick	2 279	9 967	3 404	13 602	2 329	11 941
Quebec	5 486	57 404	6 030	61 641	7 078	64 725
Ontario	2 546	x	3 304	x	3 158	x
Manitoba	326	x	308	x	388	x
British Columbia	3 544	x	3 984	x	3 548	x
Northwest Territories	84	x	1 504	x	607	x
Total	22 054	204 794	27 005	233 463	25 002	223 874
BY USE						
Stone (Dimension)						
Dimension stone						
Rough	175	30 252	168	32 378	. .	. .
Monumental and ornamental stone (n.f.)	59	9 509	69	8 543	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	3	721	3	665	. .	. .
Total dimension stone	238	40 481	240	41 585	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	2 818	18 245	2 950	20 434	. .	. .
Asphalt aggregate	4 310	29 692	4 681	33 053	. .	. .
Road metal	5 190	28 091	6 913	37 458	. .	. .
Railroad ballast (includes traprock)	1 510	13 582	1 354	12 090	. .	. .
Other uses	6 093	35 456	8 933	48 507	. .	. .
Chemical process stone						
Cements plants, Canada	30	210	31	217	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	–	–	–	–	. .	. .
Roofing granules	730	35 803	671	37 798	. .	. .
Poultry grit	1	75	1	100	. .	. .
Stucco dash	. . .	63	. . .	33	. .	. .
Rock wool	23	421	27	413	. .	. .
Rubble and riprap	288	1 533	304	1 200	. .	. .
Other uses	703	1 236	794	609	. .	. .
Pulverized stone						
Asphalt filler	132	64	115	64	. .	. .
Other uses	18	90	22	119	. .	. .
Total crushed stone	21 846	164 562	26 796	192 095	. .	. .
Total all stone	22 084	205 043	27 036	233 680	. .	. .

Source: Natural Resources Canada.

– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; (p) Preliminary; x Confidential.

Notes: Numbers may not add to totals due to rounding. Data include shipments by producers regardless of industrial classification. Granite may include other igneous rocks (e.g., basaltic roofing granules).

TABLE 7. CANADA, SANDSTONE PRODUCTION, 2000-02

	2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE (1)						
Newfoundland and Labrador	1 035	4 036	992	3 344	690	2 976
Nova Scotia	1 418	7 732	1 448	8 446	1 440	8 375
New Brunswick	68	x	64	x	60	x
Quebec	2 351	18 860	2 052	19 417	1 988	17 506
Ontario	18	2 451	87	2 575	67	2 411
Manitoba	1	x	–	–	–	–
Alberta	–	–	1	x	1	x
British Columbia	18	x	4	x	. .	x
Total	4 910	34 150	4 649	33 984	4 247	31 537
BY USE (2)						
Stone (Dimension)						
Dimension stone						
Rough	58	8 535	69	9 968	. .	. .
Monumental and ornamental stone (n.f.)	6	174	1	86	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	7	532	8	614	. .	. .
Total dimension stone	72	9 241	77	10 667	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	241	1 391	224	1 302	. .	. .
Asphalt aggregate	425	3 043	585	3 798	. .	. .
Road metal	1 486	6 647	1 329	5 208	. .	. .
Railroad ballast (includes traprock)	85	318	30	213	. .	. .
Other uses	2 073	10 717	1 891	10 276	. .	. .
Chemical process stone						
Cement plants, Canada	141	816	177	892	. .	. .
Cement plants, foreign	18	98	4	23	. .	. .
Flux in nonferrous smelters	56	704	50	317	. .	. .
Other chemical uses	–	–	–	–	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	–	–	–	–	. .	. .
Roofing granules	10	118	10	119	. .	. .
Rubble and riprap	242	600	235	649	. .	. .
Other uses	36	154	37	203	. .	. .
Pulverized stone						
Whiting	–	–	–	–	. .	. .
Other uses	165	1 119	174	1 209	. .	. .
Total crushed stone	4 979	25 725	4 749	24 209	. .	. .
Total all stone	5 051	34 965	4 826	34 876	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; n.f. Not finished or dressed; (p) Preliminary; x Confidential.
(1) Data exclude stone used in the Canadian cement industry. (2) Data include stone used in the Canadian cement industry.
Note: Numbers may not add to totals due to rounding.

TABLE 8. CANADA, SHALE PRODUCTION,[1] 2000-02

	2000		2001		2002 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY (2)						
Newfoundland and Labrador	158	490	240	2 998	178	2 894
Nova Scotia	24	x	24	x	25	x
New Brunswick	295	x	116	x	205	x
Quebec	214	x	1 262	x	1 149	x
Ontario	28	1 279	10	1 244	7	728
Manitoba	132	79	240	x	154	x
Alberta	15	x	14	x	14	x
British Columbia	48	313	45*	x	54	x
Northwest Territories	33	x	23	x	13	x
Total	948	14 504	1 976	17 590	1 800	18 451
BY USE (3)						
Stone (Dimension)						
Dimension stone						
Rough	26	3 317	24	3 403	. .	. .
Monumental and ornamental sonte (n.f.)	–	–	1	14		
Other (flagstone, curbstone, paving blocks, etc.)	15	6 641	17	6 396	. .	. .
Total dimension stone	41	9 958	43	9 812	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	–	–	–	–	. .	. .
Asphalt aggregate	10	20	4	21	. .	. .
Road metal	308	836	1 503	5 633	. .	. .
Railroad ballast (includes traprock)	–	–	12	65		
Other uses	490	3 381	289	1 687	. .	. .
Chemical process stone						
Cement plants, Canada	662	2 301	513	1 734	. .	. .
Cement plants, foreign	38	160	32	135		
Other chemical uses	835	3 067	1 086	3 863	. .	. .
Miscellaneous stone						
Rubble and riprap	1	1	2	5	. .	. .
Other uses	60	148	90	233	. .	. .
Total crushed stone	2 404	9 914	3 532	13 375	. .	. .
Total all stone	2 445	19 872	3 575	23 188	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; (p) Preliminary; x Confidential.
(1) May include slate. (2) Data exclude stone used in the Canadian cement and clay industries. (3) Data include stone used in the Canadian cement and clay industries.
Note: Numbers may not add to totals due to rounding.

TABLE 9. CANADA, ROUGH GRANITE, SUMMARY OF PRODUCTION AND TRADE, 1986-2002

	Quantity Value	Production (1)	Imports (2)	Exports (2)
1986	t	121 000	33 994	(a) 18 450
	$ millions	15.7	6.6	2.7
1987	t	112 000	46 370	(a) 37 450
	$ millions	16.1	7.9	6.0
1988	t	153 000	46 282	86 940
	$ millions	24.4	11.2	(r) 16.2
1989	t	162 000	52 337	107 105
	$ millions	24.8	11.7	17.3
1990	t	166 000	46 149	(r) 79 640
	$ millions	33.6	11.2	(r) 19.8
1991	t	122 000	35 038	(r) 91 630
	$ millions	24.0	8.5	22.6
1992	t	127 000	44 951	(r) 94 530
	$ millions	20.3	10.5	21.4
1993	t	134 000	41 484	(r) 88 830
	$ millions	18.1	10.8	20.3
1994	t	112 000	35 619	(r) 95 000
	$ millions	16.9	10.1	20.0
1995	t	158 000	41 099	(r) 94 200
	$ millions	19.6	11.4	17.9
1996	t	163 000	53 543	(r) 97 700
	$ millions	24.6	15.4	20.9
1997	t	161000	54 639	(r) 80 194
	$ millions	24.5	16.0	16.4
1998	t	163 000	75 186	(r) 69 937
	$ millions	27.3	23.0	15.1
1999	t	193 000	68 770	(r) 73 687
	$ millions	32.8	23.2	16.5
2000	t	238 000	(r) 66 041	(r) 95 680
	$ millions	40.5	(r) 21.9	19.4
2001	t	240 000	85 467	(r) 110 828
	$ millions	41.6	27.9	20.0
2002	t	(e) 255 000	84 196	126 482
	$ millions	40.0	29.0	16.6

Sources: Natural Resources Canada; Statistics Canada.
(e) Estimated; (r) Assumes a factor of 2.7 for converting cubic metres to tonnes.
(a) Coded as building stone, rough (90% is considered to be granite).
(1) Includes rough granite for construction, monumental/ornamental and other uses, as per Table 6. (2) Includes codes 2516.11 (roughly trimmed block) and 2516.12 (cut block by sawing or otherwise). Some re-exports to the United States may also be involved.

Uranium

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OVERVIEW

Uranium producers continued to face challenging market conditions in 2002 as abundant secondary supplies continued to compete for limited demand. However, the improving political climate for nuclear energy continued in 2002. This, combined with positive steps toward the long-term disposition of nuclear fuel waste in North America and a continued focus on clean air, could translate into nuclear power growth and improved market conditions for uranium producers over the next several years.

The uranium spot market price was remarkably stable through 2002, a situation that was brought about by ample inventory supplies compared to spot demand as government inventories in Russia and the United States continued to make their way to the market. Although this situation is expected to continue in the near term, Canadian uranium producers remain well positioned to capitalize on any additional market upturn as the transition to new production centres tapping high-grade, low-cost deposits in northern Saskatchewan continues.

Canadian uranium production in 2002 amounted to a total of 11 607 tU, down some 7% from the record 2001 total of 12 522 tU, mainly due to decreased contributions from the Rabbit Lake production centre. As Figure 1 shows, the world's two largest uranium-producing companies have operations in Canada. As of January 1, 2003, Canada's "known" recoverable uranium resources totalled 439 000 tU, compared with 452 000 tU as of January 1, 2002. This downward adjustment of some 3% is the result of mining depletion and ongoing deposit appraisal.

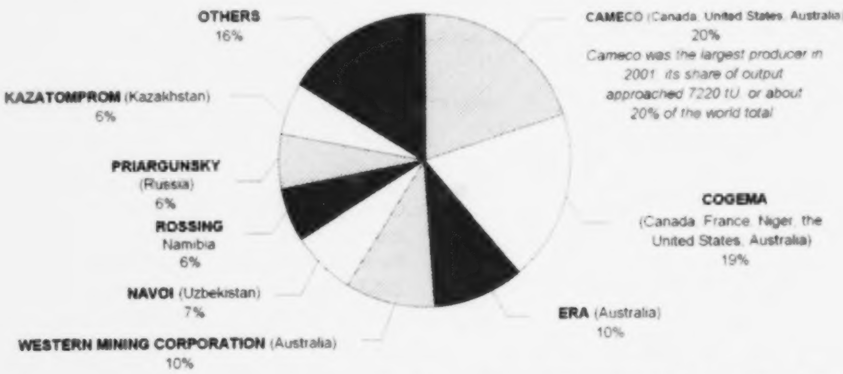
Canadian uranium production capability declined as the Cluff Lake production facility closed in December 2002 after all stockpiled ore was processed. In addition to the Cluff Lake closure, the flooding at the McArthur River mine in April 2003 that temporarily suspended production for some three months will reduce production somewhat in 2003. The timing of production at the Cigar Lake mine, which currently is not expected earlier than 2006, will depend upon market conditions and regulatory approvals.

DOMESTIC PRODUCTION AND DEVELOPMENTS

In 2001, the most recent year with complete data available, production amounted to a record total of 12 522 tU, a sharp increase of 17% from the 2000 total. Record 2001 production resulted from increased McArthur River and McClean Lake production as the mines ramped up toward full commercial production rates. Overall employment in Canada's uranium mining industry dropped slightly below 1000 in 2001 (Table 1). Shipments from mining centres increased dramatically in 2001, compared to 2000, and the total value of these shipments increased as well (Table 2). These data primarily reflect the successful transition that uranium producers are making to the new high-grade production centres as resources near depletion at older operations. With increased 2001 production, uranium continues to rank among Canada's top 10 metal commodities in terms of output value. Table 3 documents the main operational characteristics of the existing uranium production centres in Canada in 2001 and Table 4 updates the status of new projects that represent Canada's future production capability. All current production and new projects awaiting development are located in the Athabasca Basin of northern Saskatchewan. One property that is being considered for development, Kiggavik in Nunavut (Figure 2), is not likely to proceed in the foreseeable future due to market conditions and regulatory uncertainties. Uranium production in Canada in 2001 (Figure 3) was once again dominated by Cameco Corporation and COGEMA Resources Inc. (CRI).

On June 19, 2002, Cameco announced that it had acquired the Smith Ranch in situ leach (ISL) mine and related properties in Wyoming from Rio Algom Mining LLC, a subsidiary of BHP Billiton. The Smith Ranch production facility includes a mill with an annual capacity of about

Figure 1
World's Top Uranium Mining Companies in 2001



These eight companies accounted for about 83% of 2001 world production, which totaled some 36 800 tU.

Source: *World Nuclear Association Pocket Guide.*
Note: Ranking reflects equity interest in production facilities, not market share.

770 tU, as well as proven and probable reserves totalling some 10 385 tU. To acquire the facility, Cameco agreed to assume all decommissioning liabilities associated with the mine (estimated at approximately US$11 million) and to purchase approximately US$6 million of Rio Algom's uranium inventory. The Smith Ranch ISL facility is adjacent to the Highland ISL mine operated by Power Resources Inc., a wholly owned subsidiary of Cameco.

On July 17, 2002, UEX Corporation was listed for trading on the Toronto Stock Exchange. UEX is a new Canadian uranium exploration company that was created on October 21, 2001, when Cameco and Pioneer Metals Corporation announced that they had entered into an agreement to form the company to focus on uranium exploration in the Athabasca Basin of northern Saskatchewan.

Environmental management systems at the McArthur River mine and the Key Lake mill were certified under the ISO 14001 standard in 2002. The McClean Lake mine and mill, as well as the Blind River refinery and Port Hope conversion plant, have already achieved this internationally recognized standard, which outlines the key requirements that companies should comply with in order to operate in an environmentally responsible manner. Thus, the front end of the nuclear fuel cycle meets rigorous international standards in Canada.

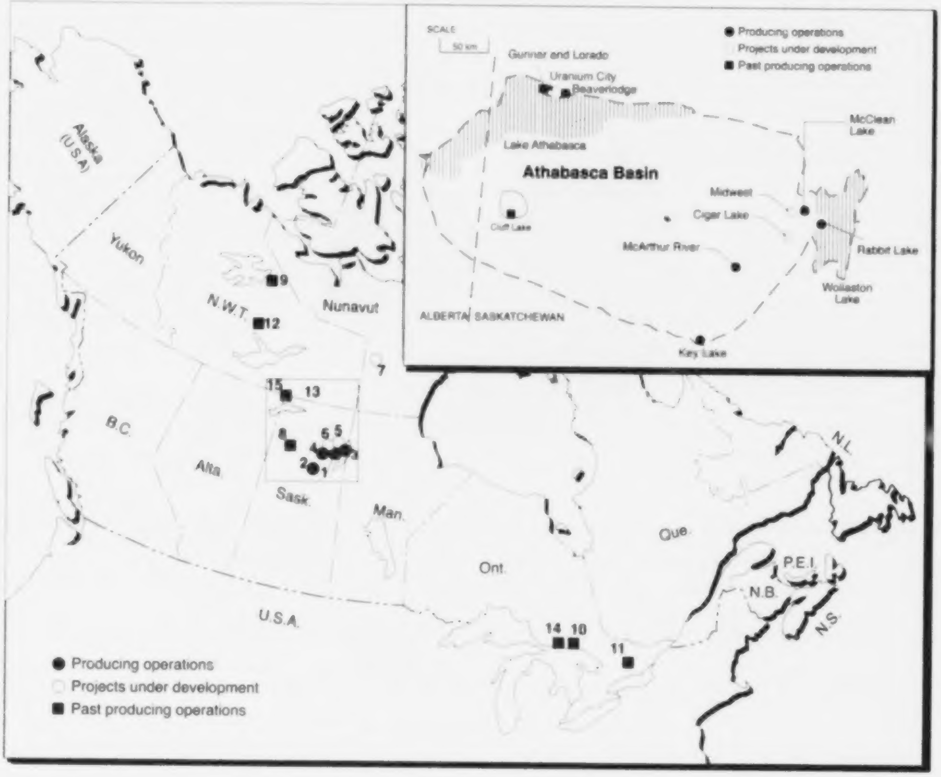
Elliot Lake, Ontario

Elliot Lake, Ontario, was a major uranium mining centre in Canada for over four decades. Since the last facility closed in 1996, Rio Algom Limited and Denison Mines Limited have completed an environmental assessment process and, by the late 1990s, had finalized the majority of the major reclamation work. Comprehensive environmental monitoring indicates that this decommissioning effort has been successful since the fish, benthic invertebrates and wildlife residing in the watershed that hosted the mining for over 40 years are displaying no adverse effects.

Some of the older, historic waste sites (containing uranium mine tailings and other uranium mine wastes produced prior to 1968) in the Elliot Lake area were stabilized with a vegetation cover to control dust and surface run-off during decommissioning in the 1970s and were then upgraded with remedial work performed in the 1990s. Run-off and seepage from these sites continue to be collected for treatment.

On August 16, 2002, the Canadian Nuclear Safety Commission (CNSC), following an environmental assessment and public hearings, issued a Radioactive Waste Facility Operating Licence to Rio Algom for these historic facilities (Spanish American, Milliken, Lacnor, Nordic/Buckles and Pronto) with a term ending December 31, 2005. These sites are designed for the storage of mine wastes produced during past mining operations and no other wastes are to be imported or added to them. Activities under this licence include regular inspection and maintenance, treatment of effluent water, and environmental monitoring. Rio Algom's environmental management system is certified under the ISO 14001 standard.

Figure 2
Uranium Mining in Canada, 2002


SCALE
50 km
Gunnar and Lorado
Uranium City
Beaverlodge
Lake Athabasca
Athabasca Basin
Cluff Lake
Midwest
Cigar Lake
McArthur River
McClean Lake
Rabbit Lake
Wollaston Lake
Key Lake
ALBERTA SASKATCHEWAN
● Producing operations
○ Projects under development
■ Past producing operations
Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
N.L.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
● Producing operations
○ Projects under development
■ Past producing operations

Numbers refer to locations on map above.

PRODUCING OPERATIONS

1. Rabbit Lake
2. Key Lake
3. McClean Lake
4. McArthur River

PROJECTS UNDER DEVELOPMENT

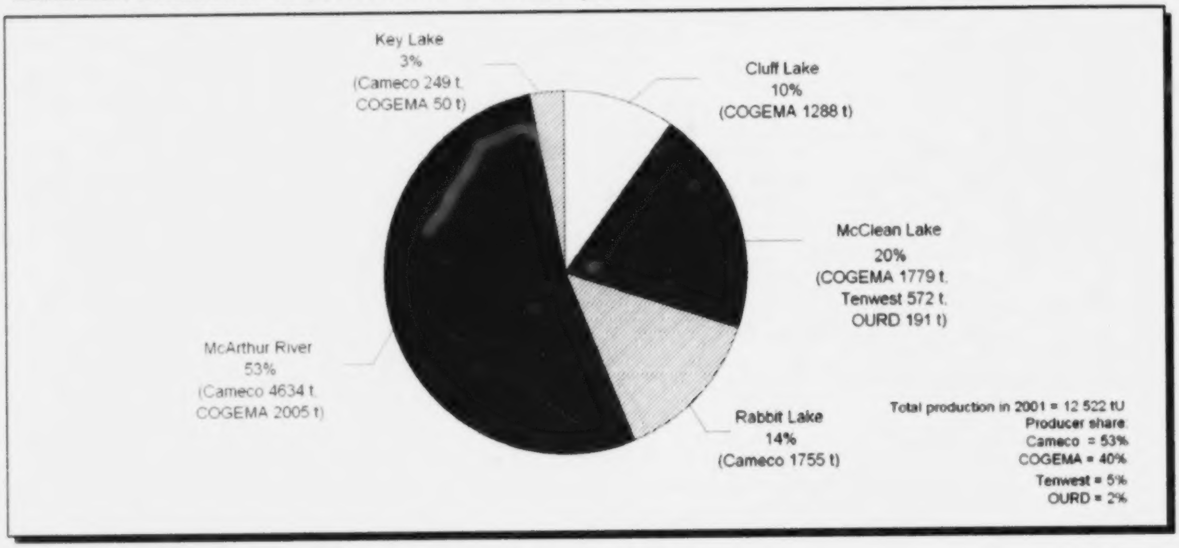
5. Midwest
6. Cigar Lake
7. Kiggavik

PAST PRODUCING OPERATIONS

8. Cluff Lake
9. Port Radium
10. Agnew Lake
11. Madawaska et al (Bancroft)
12. Rayrock (Marian River)
13. Beaverlodge et al
14. Quirke/Panel/Denison and Stanleigh et al (Elliot Lake)
15. Gunnar and Lorado et al

Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

Figure 3
Canadian Uranium Production and Ownership, 2001



Source: Uranium and Radioactive Waste Division, Natural Resources Canada.
Cameco: Cameco Corporation; COGEMA: COGEMA Resources Inc.; OURD: OURD (Canada) Co., Ltd.; Tenwest: Tenwest Uranium Ltd.
Notes: Production reflects equity interest in production facilities. Tenwest is a wholly owned subsidiary of Denison Mines Limited.

Athabasca Basin, Saskatchewan

McArthur River

The McArthur River mine, the world's largest high-grade uranium deposit discovered to date, is a Cameco-CRI joint venture operated by Cameco. About 20% of total world production (7082 tU) came from the mine in 2002, compared to the 6639 tU produced in 2001.

On April 6, 2003, unstable ground conditions were encountered that caused the roof of an underground development drift to collapse. No one was injured in the incident as the mine had been evacuated prior to the collapse. Production was halted until all inflowing water was pumped to the surface and treated for release and a bulkhead was constructed to block additional inflows. It is expected that the mine will resume production in July 2003.

Key Lake

The Key Lake project is a Cameco and CRI joint venture operated by Cameco. Local deposits were mined out in 1997, but the mill continues operating as it is processing all McArthur River ore. In 2002, Key Lake produced a total of 7199 tU, an increase of about 4% over the 2001 total of 6938 tU. All but 117 tU of the 2002 production was derived from McArthur River. The small contribution from Key Lake came from stockpiled mineralized, low-grade waste rock that is used to lower the McArthur River ore grade to about 3.5% U before being run through the mill circuit.

On December 18, 2002, an environmental assessment under the *Canadian Environmental Assessment Act* (CEAA) of a proposal to recycle uranium by-products from the Blind River refinery and the Port Hope conversion plant at Key Lake was initiated. A screening report environmental assessment is required before the CNSC can make a decision on Cameco's application to amend the Key Lake uranium mill operating licence to permit the recycling. Following the closure of the last uranium mill in Elliot Lake, Ontario, recyclable products from the Blind River and Port Hope facilities in Ontario have been processed at the White Mesa mill in Utah.

McClean Lake

The McClean Lake uranium production facility is majority-owned and operated by CRI. In 2002, production amounted to 2342 tU, down slightly from the 2540 tU produced in 2001. Mining of the Sue C open pit was completed in early February 2002 and the McClean Lake mill was fed throughout the year by stockpiled ore from the JEB and Sue C deposits. This ore stockpile is expected to be sufficient to provide feed for the mill until the end of 2005.

On September 23, 2002, the Federal Court of Canada issued an order to quash a McClean Lake operating licence on the grounds that an environmental assessment under the CEAA had not been conducted prior to issuing the licence. In November 2002, the CNSC and CRI successfully applied to the Federal Court of Appeal for a stay of the order until the appeal is heard. The Court order deals with the application of the transitional provision of the CEAA and is not a criticism of the environmental performance facility. The McClean Lake facility has performed as predicted and has met or exceeded all environmental requirements of the regulatory agencies.

The stay allows CRI to operate the facility until the appeal is heard. As of June 2003, a date had not been set for the appeal hearing. Early in 2003, CRI applied to the CNSC for the revocation of its current operating licence and the issuance of a new one for McClean Lake. On April 17, 2003, an environmental assessment of the project under the CEAA was initiated. Completion of the screening report environmental assessment is required before the CNSC makes a decision on the application from CRI.

A lockout in response to a strike notice by the Communications, Energy and Paperworkers Union closed the McClean Lake mill on June 9, 2003. Unionized workers at both McClean Lake and Cluff Lake ratified a new three-year contract agreement on June 11, 2003, and operations resumed at McClean Lake a few days thereafter.

Rabbit Lake

The Rabbit Lake production facility is wholly owned and operated by Cameco. Mill output in 2002 amounted to 440 tU, down significantly from 2001 production of 1755 tU, mainly due to a decision to suspend mining and milling operations in March 1999 and May 2001, respectively, due to market conditions. The Eagle Point underground mine was re-opened in April 2002 following a re-evaluation of the mining plan. The first ore was produced in July 2002 and the mill resumed operations at the end of August 2002.

The start-up of the mill proceeded smoothly and it has operated on a cyclical basis, dictated by mine output, since the re-opening. During the resumption of mining activities, however, Cameco faced challenges with respect to poor ground conditions and radiation protection. Although all regulatory requirements were met, the company developed a modified mining plan and implemented a number of new radiation protection initiatives to overcome these challenges. The time taken to develop and implement these actions reduced output.

Rabbit Lake reserves are expected to provide feed for the mill until early 2005. Cameco is conducting an exploration program to identify additional reserves to extend the life of the facility. In addition, an environmental assessment of a proposal to process approximately 50% of the ore from the Cigar Lake mine at Rabbit Lake (providing some 15 years of feed for the mill) is expected to be filed with regulatory agencies in 2004. Deliveries of Cigar Lake ore to Rabbit Lake may commence as early as 2008.

Cluff Lake

The Cluff Lake uranium production facility is wholly owned and operated by CRI. In 2002, its final year of operation, the mill operated on an alternate week schedule throughout most of the year and produced 1626 tU, up significantly from the 1288 tU produced in 2001. The increased production was the result of the higher ore grades encountered during the final phase of mining. Mining was stopped in May 2002 and all stockpiled ore was milled by the end of December 2002, bringing to a close a long and successful chapter in Canadian uranium mining.

In its 22 years of operation, the Cluff Lake facility produced some 24 000 tU, generated significant employment and business opportunities for residents of northern Saskatchewan, and set high standards for uranium production and workplace safety. Cluff Lake won the John T. Ryan Award for achieving the lowest lost-time accident rate at a Canadian metal mine in both 1998 and 2002.

Once an environmental assessment of the decommissioning plan (initiated on April 15, 1999) is completed and all regulatory approvals have been obtained, CRI will begin the decommissioning process. In the interim, CRI has initiated preliminary clean-up activities, such as mothballing the mill, demolishing surplus buildings, cleaning up ore storage areas, and adding a layer of soil material to level the lower solids area of the tailings management area.

Cigar Lake

The Cigar Lake mine is a joint venture being developed by Cameco (Table 4). It is the world's second largest high-grade uranium deposit discovered to date with reserves totalling more than 85 000 tU at an average grade of over 17% U. In January 2003, Cameco applied for a CNSC licence to begin construction of commercial facilities at the site where test mining has been conducted at various times since the discovery of the deposit in 1981. Envisaged construction includes development of a second mine access shaft, an underground ore preparation circuit, surface ore storage and loading facilities, and upgraded water treatment and camp facilities.

Since the federal court decision that quashed a McClean Lake operating licence has introduced uncertainty in environmental assessment requirements, the CNSC exercised caution in the Cigar Lake construction licence application and determined that an environmental assessment screening report pursuant to the CEAA must be prepared in support of the application for a construction licence. Subject to favourable regulatory approvals and market conditions, the Cigar Lake mine is now expected to begin production no earlier than 2006.

In August 2002, Cameco and CRI submitted an addendum to the 2001 environmental assessment of options for disposing of potentially acid-generating waste rock from the Cigar Lake mine in response to comments and questions received during regulatory reviews of the report. Although disposal of Cigar Lake waste rock in the mined-out Sue C pit at McClean Lake remains the preferred option, the proponents have determined that two two-year long-haul campaigns (roughly 20 and 40 years into the Cigar Lake project life) is the environmentally preferred transport option. The CNSC has scheduled a one-day public hearing on June 25, 2003, to review the environmental assessment screening report.

Additional Production Possibilities

Beyond the existing and committed centres of uranium production mentioned above, there are two projects that could be brought on stream in the future, subject to market conditions and the receipt of environmental and regulatory approvals. Table 4 updates, as of June 1, 2003, recent developments at the mining projects that could contribute to Canada's future uranium production capability.

Other Developments Affecting Canada's Uranium Industry

On December 23, 2002, Cameco announced its intention to increase its stake in the Bruce Power Limited Partnership. Bruce Power was initially a joint venture involving British Energy plc (80%), Cameco (15%), the Power Workers' Union (4%) and The Society of Energy Professionals (1.2%). As the result of a transaction that closed on February 14, 2003, British Energy divested all of its interests in the Bruce nuclear power generating station to a Canadian consortium. Cameco acquired an additional 16.6% ownership stake for a combined 31.6% ownership. TransCanada PipeLines and BPC Generation Infrastructure Trust (a trust established by the Ontario Municipal Employees Retirement System) each acquired 31.6% with the two unions maintaining the balance.

The Bruce nuclear power station consists of four Bruce B reactors currently in operation and four laid-up Bruce A reactors. Bruce Power continues to work toward the restart of two of the laid-up Bruce A reactors (Units 3 and 4, an additional 1500 MWe) with both expected to be back in operation in 2003, subject to regulatory approvals.

On July 22, 2002, Cameco announced that it had entered into a memorandum of agreement (MOA) that represented an initial step toward a formal agreement with a consortium that is working toward establishing a $1.5 billion uranium enrichment facility in the United States. Under the terms of the MOA, Cameco was to have obtained, upon entering into the partnership, a 20% interest in the project. Following receipt of a licence and a final restructuring of the partnership, Cameco's interest would have increased to 25%. However, on March 10, 2003, Cameco announced that it was withdrawing from the partnership because the venture did not meet the company's requirements.

EXPLORATION

Natural Resources Canada (NRCan) completed its 27th annual assessment of Canada's uranium supply capabilities and reported[2] the results in October 2002. Uranium exploration activity remains concentrated in areas favourable for the occurrence of deposits associated with Proterozoic unconformities, notably in the Athabasca Basin of Saskatchewan and the Thelon Basin of the Northwest Territories and Nunavut. In 2001, overall uranium exploration expenditures amounted to $25 million while uranium exploration and surface development drilling totalled over 48 000 m, down from the 77 000 m reported for 2000.

In 2001, slightly less than half of the overall exploration expenditures can be attributed to advanced underground exploration, deposit-appraisal activities and care-and-maintenance expenditures associated with those Saskatchewan projects awaiting production approvals. In comparison, the Saskatchewan government estimates that "grass-roots" uranium exploration in the province amounted to $14 million in 2001, down slightly from the 2000 total of $18 million. Table 5 summarizes uranium exploration activity in Canada from 1988 to 2001.

In recent years, the number of companies with major exploration programs in Canada has declined. The top five operators,[3] accounting for a major portion of the $25 million expended in 2001, were: Cameco Corporation, CRI, JNR Resources Inc., Kennecott Canada Exploration, and Pioneer Metals Corporation. Expenditures by CRI include those of Urangesellschaft Canada Limited.

RESOURCES

NRCan's annual assessment of domestic uranium supply capability provides a compilation of Canada's "known" uranium resources based on the results of an evaluation of company data. Uranium supply from Canada in the next decade will come from known resources, estimates of which are divided into three major categories (measured, indicated and inferred) that reflect different levels of confidence in the reported quantities. Most of these resources are associated with deposits identified in Figure 2.

Recent NRCan assessments of Canada's uranium resources have been restricted to those recoverable from mineable ore at prices of $100/kgU or less. Table 6 shows the breakdown of the latest resource estimates, compared with those of the previous year. As of January 1, 2002, total recoverable known uranium resources were estimated at 452 000 tU, compared with 437 000 tU as of January 1, 2001. This upward adjustment of some 3% is the result of ongoing resource assessment.

SUPPLY CAPABILITY

At the end of 2002, Canada's uranium supply capability declined as production at Cluff Lake had ended. A continued smooth transition to other new mines, notably Cigar Lake, combined with timely licensing approvals and improved market conditions, will be required to allow Canada's production capability to expand to its full potential of some 16 000 tU annually.

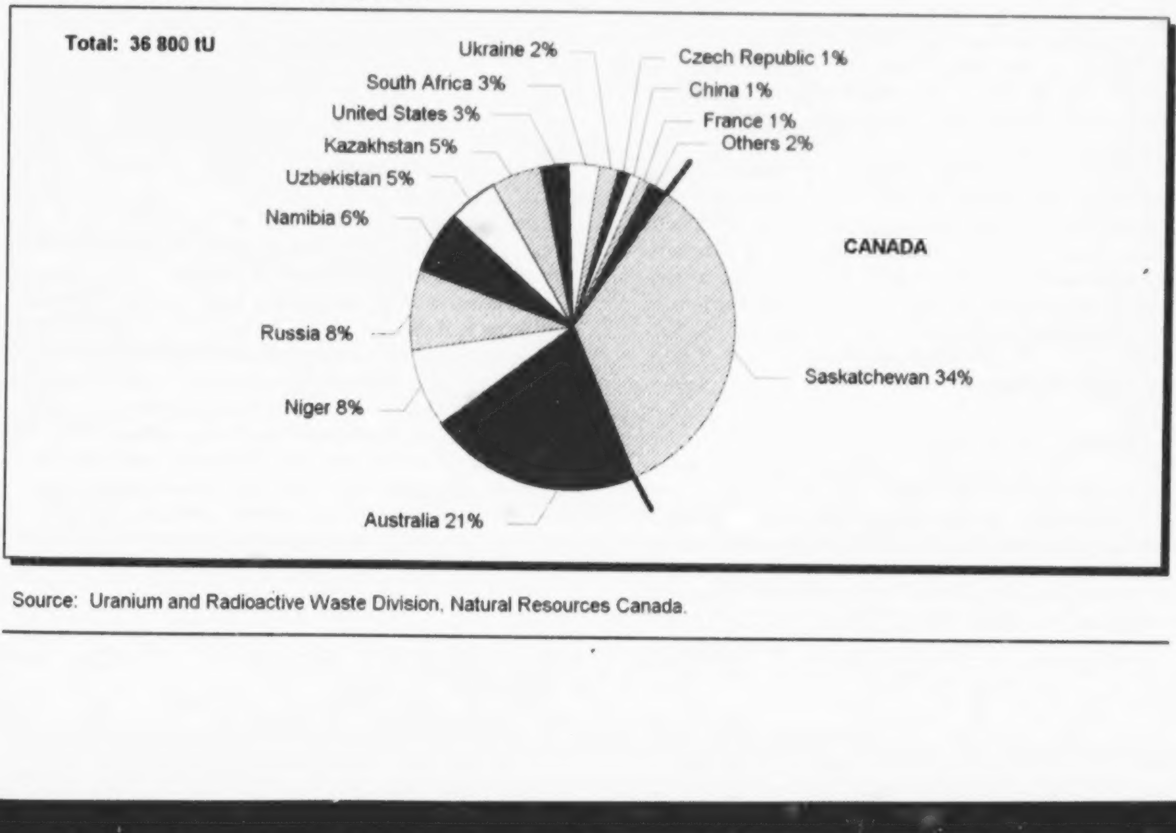
Developments in the international uranium market, the rate at which projects receive environmental approvals, and uncertainty regarding the costs associated with certain of the planned new projects preclude projecting future production capability levels with much certainty. Table 7 ranks Canada among the world's major producers, showing actual uranium production from 1997 through 2001. Figure 4 illustrates Canada's share of world output in 2001 compared with other major producers.

GOVERNMENT INITIATIVES

The *Nuclear Fuel Waste (NFW) Act* came into force on November 15, 2002. The act requires nuclear utilities to form a waste management organization. Under the act, the organization's mandate is to propose to the Government of Canada approaches for the long-term management of nuclear fuel waste and to implement the approach that is selected by the Government. The NFW Act also requires the utilities and Atomic Energy of Canada Limited to establish trust funds to finance the implementation of the selected long-term nuclear fuel waste management approach.

The *Nuclear Safety and Control (NSC) Act*, replacing the existing *Atomic Energy Control Act* of 1946, received Royal Assent in March 1997. The new act created the CNSC to replace the Atomic Energy Control Board. It came into force on May 31, 2000, with new regulations. In February 2003, subsection 46(3) of the NSC Act was amended to clarify a point concerning site remediation

Figure 4
World Uranium Production, 2001



Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

obligations that had the consequence of discouraging private-sector lending to companies that own and operate nuclear facilities.

URANIUM MARKET

Overview

The improving political climate for nuclear energy continued into 2002, perhaps setting the stage for renewal of new nuclear build a few years from now. In the United States, three major utilities secured government funding to complete the Nuclear Regulatory Commission's Early Site Permit Process. This will help the utilities evaluate whether selected nuclear sites are suitable for additional reactors and will serve as a pre-approval for the construction of new reactors at those sites. This will shorten the regulatory process in the event that the utilities decide to invest in additional plants.

The year also saw Congressional approval of the Yucca Mountain site in Nevada as the U.S. repository for spent nuclear fuel. Although still faced with a licensing process that will take several years, as well as a number of legal actions aimed at stopping it, this legislation represents a major milestone on the road to closing the back end of the nuclear fuel cycle. The political solution to this perceived problem should negate one of the strongest arguments levelled against nuclear power by its opponents and remove an important obstacle to the expansion of nuclear power.

The climate for nuclear power in Europe also improved. Britain's chief science advisor came out strongly in support of expanding nuclear power, at least to the extent of replacing those reactors that will have to be decommissioned over the next two decades. He said that nuclear power is vital for the nation to meet its goals of reducing greenhouse gas emissions. The European Union also released a new energy policy that called for greater diversity of supply and emphasized nuclear power's role in reducing greenhouse gas emissions while leaving the decision of whether to support nuclear power up to individual nations. During the year, the Finnish Parliament approved the construction of a new nuclear reactor and the utility involved initiated the bidding process on the first new reactor approved in Europe in over a decade.

Uranium Prices

The uranium spot market price, as reported by TradeTech,[4] was remarkably stable during 2002. After opening the year at US\$9.50/lb U_3O_8 (a standard measure of uranium metal content), it spent the next 11 months in the narrow band of \$9.75-\$9.95/lb before breaking the \$10 barrier and closing the year at \$10.20/lb (Figure 5). This stability was brought about by ample inventory supplies compared to spot demand as Russian and U.S. government inventories continued to make their way to the market. This situation is expected to continue in the near term.

Commencing in 2002, Natural Resources Canada has decided to suspend the publication of the *Average Price of Deliveries under Export Contracts for Uranium* for a period of three to five years pending a policy review and assessment of market conditions. Table 8 indicates actual exports of Canadian-origin uranium to principal customers from 1996 to 2001. The destination of Canada's exports of uranium on a cumulative basis (1997-2001 inclusive) is illustrated in Figure 6, which highlights the importance of the United States as a customer.

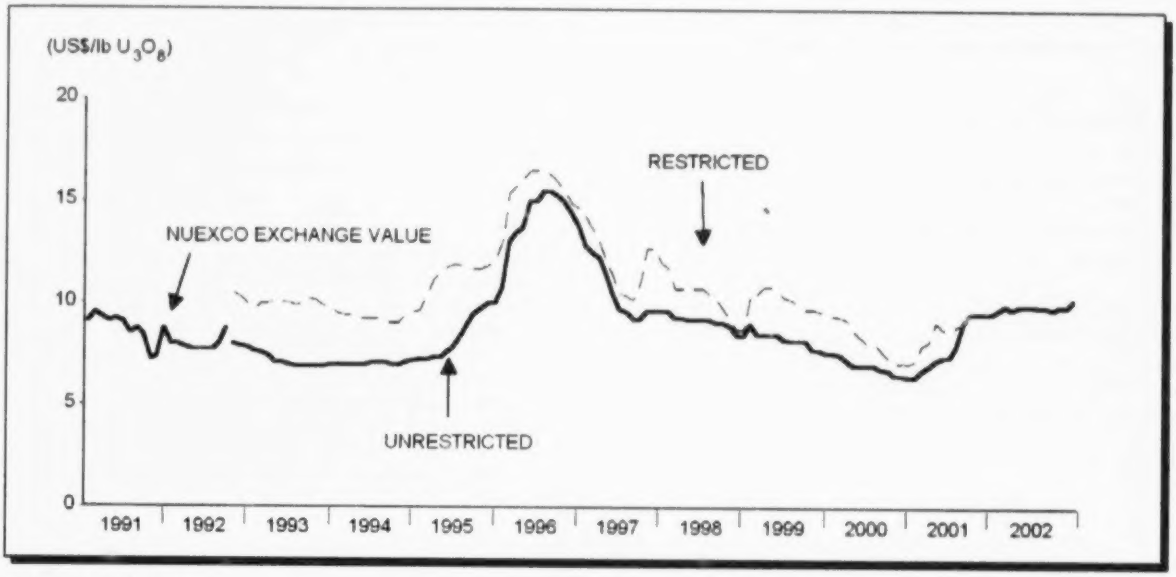
REFINING AND CONVERSION

Cameco operates Canada's only uranium refining and conversion facilities, located at Blind River and Port Hope, Ontario, respectively. At the Blind River refinery ~ the world's largest ~ uranium mine concentrates from Canada and abroad are refined to uranium trioxide (UO_3), an intermediate product. The UO_3 is then trucked to the Port Hope facilities, which have about one quarter of the Western World's annual uranium hexafluoride (UF_6) conversion capacity and currently provide the only commercial supply of fuel-grade natural uranium dioxide (UO_2). UF_6 is enriched outside Canada for use in foreign light-water reactors while natural UO_2 is used to fabricate fuel bundles for CANDU reactors in Canada and abroad. About 80% of the UO_3 from Blind River is converted to UF_6 while the remaining 20% is converted to UO_2. Table 9 tabulates Canada's production of refined and converted uranium, and notes the associated work force, from 1998 to 2001 inclusive.

OUTLOOK

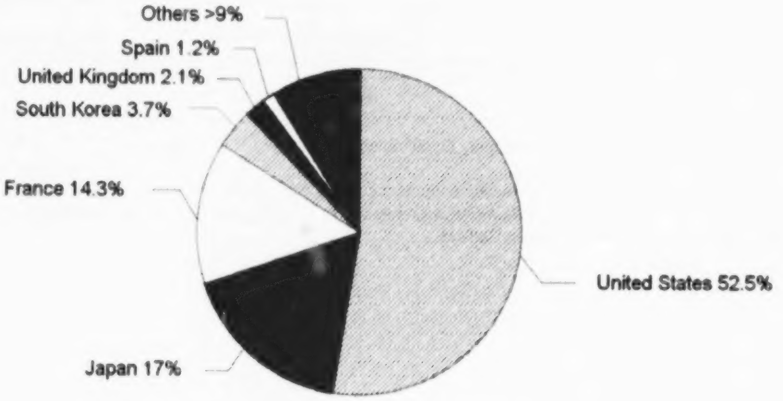
Continued improvement in the political climate for nuclear energy in 2002, particularly in the United States, was good news for uranium producers in Canada. This, combined with positive steps toward the long-term disposition of nuclear fuel waste, could pave the way for growth in the nuclear power sector. Improved market conditions will be welcomed by Canadian producers as the transition to a new generation of uranium mines continues in northern Saskatchewan. Continued success in bringing these environmentally sustainable operations on stream, notably the Cigar Lake mine, will ensure that Canada remains the world's premier uranium producer well into the 21st century.

Figure 5
Trend in Uranium Spot Prices, 1992-2002



Source: TradeTech.

Figure 6
Canadian Uranium Exports, by Country of Final Destination, 1997-2001



Exports over five years total 46 642 tU.

Source: Canadian Nuclear Safety Commission.

REFERENCES

[1] John French, Advisor, Uranium Markets (tel. 613-995-7474), has contributed to the text in those sections dealing with international uranium market developments and uranium prices.

[2] *Canada's Uranium Industry - Record Production in 2001*, NRCan mailing, October 2002.

[3] In certain cases, the identified operator has reported the total expenditures of a joint-venture effort. Therefore, contributions by other parties not responding to the NRCan survey are accounted for in the $25 million total expenditure for 2001.

[4] NUEXCO, an international uranium brokerage firm, was originally called the Nuclear Exchange Corporation. Several companies in the NUEXCO organization that were associated with uranium trading declared bankruptcy in early 1995. Certain of these have been reorganized and continue to provide brokerage services. NUEXCO's publication activities are carried on by TradeTech.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to chapter 64. (2) Information in this review was current as of June 1, 2003. (3) This paper on uranium and other information on developments in Canadian nuclear policy can be accessed on the Internet at http://nuclear.nrcan.gc.ca. (4) This and other reviews, including previous editions, are also available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

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TABLE 1. URANIUM PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1999-2001

	Company Work Force (1) (Dec. 31)			Annual Output (2) (tU)		
Production Centre and Producer	1999	2000	2001	1999	2000	2001
ATHABASCA BASIN, SASKATCHEWAN						
Cluff Mining (COGEMA Resources Inc., 100%)	151	105	98	1 234	1 443	1 288
Key Lake JV (Cameco operator)	277	260	289	3 715	402	299
Rabbit Lake JV (Cameco, 100%)	155	156	66	2 705	2 790	1 755
McClean Lake JV (COGEMA Resources Inc. operator)	283	258	238	560	2 308	2 540
McArthur River JV (Cameco operator)	157	225	263	–	3 740	6 639
Cigar Lake JV (pre-production)	53	22	19	–	–	–
Total	1 134	1 026	973	8 214	10 683	12 522

Sources: Company annual reports; Canadian Nuclear Safety Commission open files.
– Nil.
(1) Figures are for company payroll employees only; on-site contractors (mining, construction, services, etc.) are not included. (2) Primary output only. With the closure of Rio Algom Limited's Stanleigh operation at Elliot Lake in mid-1996, by-products from Cameco's refinery/conversion facilities are no longer processed in Canada.

TABLE 2. VALUE(1) OF URANIUM SHIPMENTS(2) BY PRODUCERS IN CANADA, 1997-2001

	Unit	1997	1998	1999	2000	2001 (p)
Total producer shipments	tU	11 127	9 984	10 157	9 921	12 922
Total value of shipments	$ millions	554	500	500	485	600

Source: Natural Resources Canada.
(p) Preliminary.
(1) Value of shipments is estimated from an average market price. (2) Shipments in tonnes of uranium (tU), contained in concentrate, from ore-processing plants.

TABLE 3. OPERATIONAL CHARACTERISTICS OF EXISTING CANADIAN URANIUM PRODUCTION CENTRES, 2001

Operating Entity (Operator)/Location	Ore-Processing Plant (1)			
	Capacity	Recovery	Annual Throughput	
	Nameplate	Overall	Total Ore	Ore Grade
	(t/d)	(%)	(t)	(%)
Cluff Mining (COGEMA Resources Inc.)/ Cluff Lake, Saskatchewan	800	97	58 500	2.27
McClean Lake JV (COGEMA Resources Inc.)/ McClean Lake, Saskatchewan	300	98	98 400	2.63
Rabbit Lake (Cameco Corporation)/ Rabbit Lake, Saskatchewan	1 920	97	139 300	1.14
Key Lake JV (Cameco Corporation)/ Key Lake, Saskatchewan (2)	750	98	192 700	3.65

Sources: Corporate annual reports; Canadian Nuclear Safety Commission open files.
(1) Figures are rounded. (2) All McArthur River ore is processed at Key Lake.

TABLE 4. CANADIAN URANIUM MINING PROJECTS PLANNED FOR PRODUCTION AS OF JUNE 1, 2003

Project, Province or Territory/Operator	Owners Share	Deposit Type/ Discoverer and Discovery Date	Resources (Company Estimates as of May 29, 2003)	Ore Grade and Notes on Deposits	Mining Method, Milling Rate and Capacity	Project Particulars and Status	Location of Project/ Notes of Interest
	(%)						
Cigar Lake, Sask./ Cameco Corporation	Cameco (50.025), COGEMA Resources Inc. (37.100), Idemitsu (7.875), TEPCO (5)	Unconformity-related/ COGEMA Resources Inc., 1981	Overall property 135 000 tU *mineable*	Overall property grade of 14% U; grades vary from 5% to 70% U; orebody at depth of 450 m	"Non-entry" underground; "jet-boring" mining method; milling at McClean Lake and Rabbit Lake; contributing from 2300 to 6900 tU/y	$555 million project; test mining completed in 1992; EIS submitted in October 1995; Joint Panel reports November 1997; government response April 1998; EA process for construction licence initiated in June 2003	670 km N of Saskatoon; 500-m-deep shaft sunk; brine freezing of ground is required to mine the ore; production to begin as early as 2006
Midwest, Sask./ COGEMA Resources Inc.	COGEMA Resources Inc. (54.8), Redstone Resources Inc. (20.7), Tenwest Uranium Ltd. (20), OURD (4.5)	Unconformity-related/ Esso Minerals Canada, 1977 (interests of Bow Valley, Numac Oil & Gas, *et al* bought by partners)	Overall property 13 800 tU *mineable*	Overall property grade of 4.5% U; grades vary from 2% to 30% U; orebody at depth of 200 m	"Non-entry" underground; "jet-boring" mining method or open-pit; milling at McClean Lake; contributing 2300 tU/y	$80 million co-venture with McClean; in 1993, Joint Panel rejects proposal; new EIS in 1995; final hearings August 1997; Joint Panel report November 1997; government response April 1998	710 km N of Saskatoon; 185-m-deep test-mine shaft; new operator, COGEMA Resources Inc. revised EIS; start-up subject to feasibility study
Kiggavik, Nunavut/ Urangesellschaft Canada Limited	Urangesellschaft (79), COGEMA Resources Inc. (20), Daewoo Corporation (1)	Unconformity-related/ Urangesellschaft, 1977	Overall property 15 000 tU *mineable*; (more incl. Andrew Lake *et al*)	0.41% U average overall; Centre pit depth 100 m, Main pit 200 m	Open-pit mining methods; mill feed at 1200 t/d; output rate of 1200 tU/y originally expected	EIS submitted but project deemed deficient by Panel; new EIS required before project start-up	75 km W of Baker Lake; start-up not expected in the foreseeable future; >11-year mine life with tributary ore included

Notes: OURD (Canada) Co., Ltd. is a subsidiary of the Overseas Uranium Resources Development Corporation (OURD) of Japan. Urangesellschaft Canada Limited, operated by COGEMA Resources Inc., is a subsidiary of COGEMA S.A., which is wholly owned by the AREVA Group of France. Idemitsu Uranium Exploration Canada Ltd. is a wholly owned subsidiary of Idemitsu Kosan Co. Ltd. of Japan. TEPCO Resources Inc., is a subsidiary of Tokyo Electric Power Co., Inc. (TEPCO), Japan's largest nuclear power utility. Redstone Resources Inc. is a subsidiary of Franco-Nevada Mining Corporation Limited. Tenwest Uranium Ltd. is a wholly owned subsidiary of Denison Energy Inc.

TABLE 5. URANIUM EXPLORATION ACTIVITY IN CANADA, 1988-2001

	Expenditures (1)	Drilling (2)	Million-Dollar Projects (3)
	($ millions)	(km)	(no.)
1988	59	201	11
1989	58	158	11
1990	45	66	6
1991	44	67	4
1992	46	79	4
1993	40	62	5
1994	36	67	8
1995	44	75	10
1996	39	79	8
1997	58	104	6
1998	60	95	6
1999	49	89	3
2000	46	77	3
2001	25	48	3

Source: Natural Resources Canada.
(1) Direct exploration and drilling expenditures in current dollars; from the late 1980s, includes advanced underground exploration and deposit appraisal expenditures; from the mid-1990s, may also include care-and-maintenance costs associated with deposits awaiting production approvals. (2) Exploration and surface development drilling; excludes development drilling on producing properties. (3) Number of projects where direct exploration and drilling expenditures exceeded $1 million in current dollars.

TABLE 6. ESTIMATES OF CANADA'S URANIUM RESOURCES RECOVERABLE FROM MINEABLE ORE,[1] JANUARY 1, 2001, AND JANUARY 1, 2002

Price Ranges Within Which Mineable Ore is Assessed (2)	Measured		Indicated		Inferred	
	1/1/01	1/1/02	1/1/01	1/1/02	1/1/01	1/1/02
			(000 tU)			
Up to $50/kgU	258	301	20	10	103	86
$50 to $100/kgU	–	–	36	37	20	18
Total	258	301	56	47	123	104

Source: Natural Resources Canada.
– Nil.
(1) Actual or expected losses in mining recovery and ore processing have been accounted for; these factors were individually applied to resources tributary to existing or prospective production centres. In underground operations, mineable ore is generally 75-85% of the ore-in-place; higher mining recoveries are achievable in open-pit operations. Canada's weighted average ore processing recovery for existing conventional operations exceeded 97% over the 2001/2002 survey period. (2) The Canadian dollar figures reflect the price of a quantity of uranium concentrate containing 1 kg of elemental uranium. The prices were used in determining the cut-off grade at each deposit assessed, taking into account the mining method used and the processing losses expected. The price of $100/kgU was used by Natural Resources Canada to illustrate those resources that were of economic interest to Canada during the survey period.
Note: $1/lb U_3O_8 = $2.6/kgU.

TABLE 7. PRODUCTION OF URANIUM IN CONCENTRATES BY SELECTED MAJOR PRODUCING COUNTRIES, 1997-2001

	1997	1998	1999	2000	2001
			(tonnes U)		
Canada	12 030	10 920	8 210	10 680	12 520
Australia	5 520	4 910	5 980	7 580	7 580
China	500	500	500	500	700
France	750	510	440	310	180
Gabon	470	730	290	–	–
Kazakhstan	1 000	1 270	1 350	1 740	2 110
Namibia	2 900	2 760	2 690	2 710	2 240
Niger	3 500	3 730	2 920	2 900	2 920
Russia	2 000	2 000	2 000	2 000	3 000
South Africa	1 100	990	980	870	880
Uzbekistan	1 760	1 930	2 130	2 350	1 950
United States	2 170	1 810	1 810	1 460	1 010
Other (1)	1 990	1 730	1 770	1 860	1 710
Total (2)	35 690	33 790	31 070	34 960	36 800

Sources: *Uranium: Resources, Production and Demand*, a biennial report published jointly by the Nuclear Energy Agency of the OECD and the International Atomic Energy Agency, and miscellaneous corporate, national and international reports.

– Nil.

(1) Includes Argentina, Belgium, Brazil, Bulgaria, the Czech Republic, Germany, Hungary, India, Israel, Japan, Mongolia, Pakistan, Portugal, Romania, Spain, Ukraine and Yugoslavia. (2) Totals are of the listed figures only and represent global production.

Note: Country figures are rounded to the nearest 10 tU.

TABLE 8. EXPORTS OF URANIUM OF CANADIAN ORIGIN, 1996-2001

Country of Final Destination	1996	1997	1998	1999	2000	2001
			(tonnes of contained uranium(1))			
Argentina	–	–	–	–	1	–
Belgium	115	–	–	–	110	126
Czech Republic	–	–	–	–	246	–
France	679	587	67	1 819	3 505	3 302
Germany	776	184	–	–	–	–
Japan	1 490	1 968	1 310	1 116	2 386	1 127
Mexico	–	–	–	–	–	93
South Korea	261	315	444	309	172	496
Spain	103	160	–	121	97	180
Sweden	142	450	147	–	–	–
Taiwan	–	–	–	107	26	212
United Kingdom	250	374	345	–	193	58
United States	7 407	6 187	5 962	3 674	4 230	4 437
Total	11 223	10 225	8 274	7 146	10 966	10 031

Source: Canadian Nuclear Safety Commission.

– Nil.

(1) Some of this uranium was first exported to an intermediate country for conversion and/or enrichment prior to transfer to the country of final destination.

TABLE 9. URANIUM PROCESSING PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1998-2001

Process and Location (Nameplate Capacity)	Production				Site Work Force			
	1998	1999	2000	2001	1998	1999	2000	2001
	(tonnes U)				(number)			
Refining at Blind River (18 000 tU as UO_3)	12 031	11 360	9 605	(1) . .	96	98	98	98
Conversion at Port Hope (12 500 tU as UF_6 and 2800 tU as UO_2)	11 169	11 231	9 327	10 958	271	272	267	264

Source: Cameco Corporation.

. . Not available.

(1) For commercial confidentiality reasons, Cameco no longer reports a production figure for Blind River.

Zinc

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Canada is an important producer and exporter of zinc and zinc products. Zinc metal production in Canada dates back to the early 1900s when the Consolidated Mining and Smelting Company of Canada (which later became Cominco Limited in 1966, followed by Teck Cominco Limited in 2001) started production at a small electrolytic zinc plant at Trail, British Columbia. With a smelting capacity of just over 800 000 t/y from four smelting facilities located across the country, Canada currently produces some 10% of the world's total supply of zinc.

HISTORY OF ZINC

Zinc is a relative newcomer to the group of metals discovered and used by society. While the first use of copper pre-dates recorded history and the discovery of tin goes back 5000 years, the first recovery of metallic zinc, however, came much later. The production of metallic zinc was first described in India around 1200 A.D. By 1374, zinc was recognized as a new metal, the eighth to be discovered at that time, and a limited amount of commercial zinc production was under way. Although brass-making had developed much earlier, the zinc in brass was obtained by treating zinc ore to produce zinc vapour, which was combined with granulated copper under heat. From India, zinc production was introduced to China sometime around 1600 A.D. and then began to be exported to Europe.

The first full-scale zinc smelting operation outside of Asia started in Bristol, England, in about 1743. By the beginning of the 19th century, zinc production was established on the continent of Europe, notably in Belgium and parts of eastern Europe. In the latter half of the century, large zinc industries developed rapidly in the United States and Germany.

ZINC IN CANADA

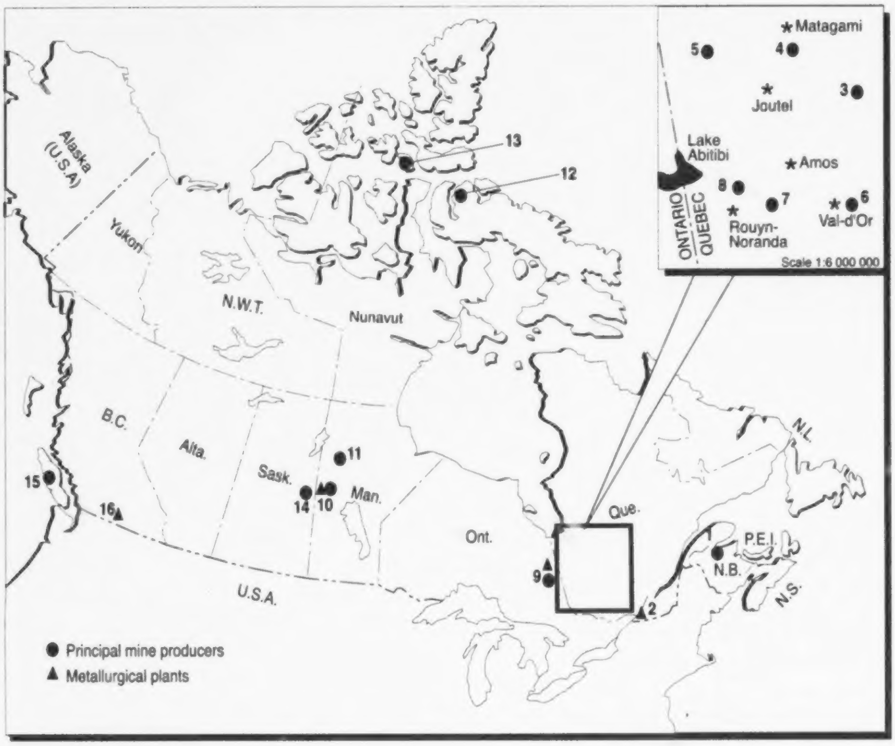
Zinc production in Canada dates back to the time around the First World War when the Consolidated Mining and Smelting Company of Canada began operating a small electrolytic zinc plant at Trail, British Columbia, to help offset a critical wartime shortage of zinc in the United Kingdom. At that time, in fact, the Consolidated Mining and Smelting Company and Anaconda Copper Mining Company in Montana were pioneering the production of zinc in North America by the electrolytic method.

The ores used at Trail came from the Sullivan mine near Kimberly, but production was hampered because the complex lead-zinc-iron ore was difficult to treat using existing methods. In 1920, however, the differential flotation method was successfully applied to separate the Sullivan ore into a lead concentrate, a zinc concentrate and an iron by-product. This marked the beginning of significant zinc production in Canada. Today the Trail operations are the world's largest, fully integrated lead and zinc smelting and refining complex. Owned and operated by Teck Cominco Limited of Vancouver, the Trail facility has a zinc production capacity of some 290 000 t/y.

In Manitoba, the discovery of significant zinc and copper ore with important quantities of gold in 1915 led to the development of the Flin Flon-Snow Lake mining camp, smelter complex and dedicated power plant in the late 1920s. Since 1930, Hudson Bay Mining and Smelting Company Limited has owned and operated some 30 mines, which in turn have fed the company's metallurgical complex at Flin Flon. Since it first started operations in 1930, the Flin Flon smelter and refinery complex has undergone significant capital improvements with the introduction of zinc pressure leach technology in the early 1990s and a new tank house in 2000 that expanded zinc production capacity to 115 000 t/y.

The Kidd Creek orebody was discovered in 1963 and Texasgulf began open-pit mining the deposit in 1966 near Timmins, Ontario. The Kidd Creek zinc plant started production in 1972. In 1983, Kidd Creek started up a zinc pressure leaching facility plant. Today, Falconbridge Limited owns and operates the Kidd Creek complex with a production capacity of 145 000 t/y.

Figure 1
Zinc Producers in Canada, 2002


Matagami
5
4
3
Joutel
Lake Abitibi
Amos
8
7
6
ONTARIO
QUEBEC
Rouyn-Noranda
Val-d'Or
Scale 1:6 000 000
Alaska (U.S.A)
Yukon
13
12
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
11
15
16
14
10
Ont.
Que.
9
2
P.E.I.
N.B.
N.S.
NL
U.S.A.
● Principal mine producers
▲ Metallurgical plants

Numbers refer to locations on map above.

ZINC-PRODUCING MINES

			WEB SITE
1.	Brunswick	Noranda Inc.	www.noranda.com
3.	Langlois (on care-and-maintenance)	Breakwater Resources Ltd.	www.breakwater.ca
4.	Bell Allard	Noranda Inc.	www.noranda.com
5.	Selbaie	Les Mines Selbaie	www.bhpbilliton.com
6.	Louvicourt	Aur Resources Inc./Novicourt Inc.	www.aurresources.com
7.	LaRonde	Agnico Eagle Mines Limited	www.agnico-eagle.com
8.	Bouchard-Hébert	Breakwater Resources Ltd.	www.breakwater.ca
9.	Kidd Creek	Falconbridge Limited	www.falconbridge.com
10.	Callinan	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
	Trout Lake	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
	Chisel North	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
	777	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
11.	Ruttan (closed June 2002)	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
12.	Nanisivik (closed September 2002)	Breakwater Resources Ltd.	www.breakwater.ca
13.	Polaris (closed September 2002)	Teck Cominco Limited	www.teckcominco.com
14.	Konuto Lake	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
15.	Myra Falls	Boliden Limited	www.boliden.ca

ZINC METALLURGICAL PLANTS

2.	Valleyfield	Canadian Electrolytic Zinc Limited	www.noranda.com
9.	Kidd Creek	Falconbridge Limited	www.falconbridge.com
10.	Flin Flon	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
16.	Trail	Teck Cominco Limited	www.teckcominco.com

With the discovery of significant zinc-bearing ores in northern Quebec and in Ontario in the late 1950s and early 1960s, Noranda Inc. began looking at options to build an electrolytic zinc plant. Construction began at Valleyfield, Quebec, just west of Montréal, in 1962 and Canadian Electrolytic Zinc (CEZ), a subsidiary of Noranda, was brought into production in 1963. The plant's capacity has increased steadily from its original 64 000 t/y at the time of opening to 260 000 t/y today.

Zinc mines have been found in every province and territory with the exception of Alberta and Prince Edward Island. Operations in 2002 are listed in Figure 1.

USES FOR ZINC

The greatest use for zinc is as a coating for iron and steel products to make them resistant to rust and corrosion. The application of a zinc coating, known as galvanizing, is accomplished electrolytically or by hot-dip methods. Galvanizing accounts for about 47% of the worldwide use of zinc.

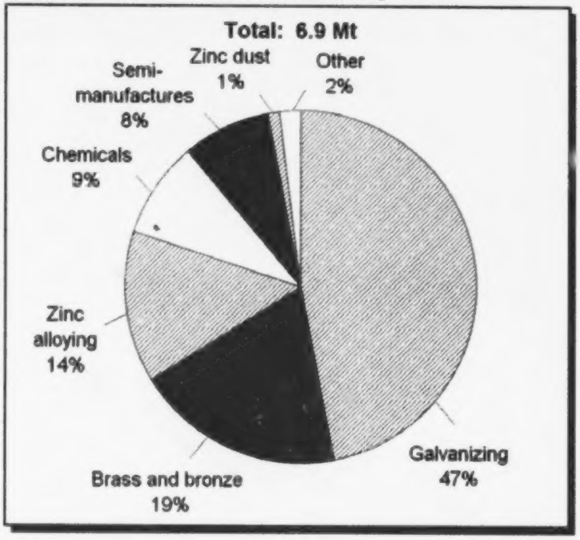
The most commonly galvanized products are sheet and strip steel, tube and pipe, and wire and wire rope. The automobile industry is the largest user of galvanized steel. The desire to reduce weight and improve fuel efficiency has led to the increased use of galvanized steel by the automotive industry to protect the thinner gauges of steel from corrosion. Both hot-dipped and electro-galvanized steel are used, the thicker coating of hot-dipped steel giving more corrosion protection to unexposed surfaces and the thinner coating of electro-galvanized steel providing a smoother finish for exposed painted surfaces.

Galvanized sheet and strip steel are also widely used by the construction industry for roofing and siding, and for heating and ventilation ducts, as well as for many other applications. Nails and other building materials are often hot-dip galvanized. Zinc and zinc-aluminum thermally sprayed coatings are used for the long-term corrosion protection of large steel structures such as bridges and hydroelectric transmission towers.

Another important use of zinc is in the manufacture of a vast range of die-cast products. Because it has a relatively low melting point and is very fluid, zinc is easy to pour when melted. Therefore, it is well suited to rapid assembly-line die-casting, particularly to produce small and intricate shapes.

A major use of die castings is in the automobile industry as trim pieces, grills, door and window handles, carburetors, pumps and other components. However, with the trend toward lighter, more energy-efficient cars, zinc demand for this purpose has declined in recent years. Other familiar zinc die castings include small electrical appliances, business machines and other light equipment, tools and toys.

Figure 2
Western World Zinc Markets, 2001



Source: International Lead and Zinc Study Group.

Another important use of zinc is in the manufacture of brass, which is essentially an alloy of copper and zinc, with the proportion of zinc ranging from 5 to 40%. The zinc brasses have good physical, electrical and thermal properties, and are corrosion resistant. They are used in plumbing, heat exchange equipment, and a wide range of decorative hardware, to name a few applications. Rolled zinc metal is a basic component in dry-cell batteries, and zinc oxide is used as a catalyst in the manufacture of rubber and as a pigment in white paint. It is also used in agricultural products, cosmetics and medicinal products.

NATURAL OCCURRENCE

Zinc is never found as a free metal but is found in association with other elements to form a number of important ores of zinc such as sphalerite (zinc blende, zinc sulphide, ZnS), smithsonite (zinc carbonate, $ZnCO_3$), zincspar (also zinc carbonate, $ZnCO_3$), and marmatite (zinc sulphide, ZnS, containing some iron sulphide, FeS). Like all metals, zinc is a natural component of the Earth's crust and is therefore present in varying concentrations in rock, soil, water and air.

In Canada, zinc deposits fall into four main categories: sedimentary exhalative (sedex); massive sulphide, Mississippi Valley-type (MVT); volcanogenic massive sulphide (VMS); and skarn deposits. As the name suggests, SEDEX deposits comprise layers of massive sulphide minerals interbedded with sedimentary rocks and tend to be associated with large deposits of lead and zinc. Examples of such deposits include the Sullivan mine in British Columbia. MVT deposits are named after large-scale lead and zinc deposits found in the region in the United States along the Mississippi River where they were first discovered. MVT deposits are characterized by a simple mineralogy that includes pyrite (iron sulphide), galena (lead sulphide), and sphalerite (zinc sulphide) hosted in undeformed calcium and magnesium-rich carbonate rocks (limestones). Examples of this type of deposit are found at the Polaris and Nanisivik mines in Nunavut, both of which closed in late 2002.

VMS deposits can be classified into sub-categories depending on their mineralogy: copper-zinc, copper-zinc-lead and Besshi-type. As found with SEDEX deposits, VMS deposits are formed through the exhalation of hydrothermal fluids on the sea floor. In the case of VMS, the host rocks are submarine igneous rocks rather than sedimentary rocks. The largest example of a VMS-type deposit in Canada is the Kidd Creek copper-zinc mine near Timmins, Ontario. Other examples include the Flin Flon copper-zinc deposits in north-central Manitoba. Many of these types of deposits can also contain significant quantities of gold, such as those deposits in the Abitibi region of northwestern Quebec. While the copper-zinc deposits are found typically associated with greenstone (mafic) volcanic host rocks such as basalts, the zinc-lead-copper deposits are associated with more felsic to intermediate volcanic rocks such as rhyolite and dacite. Examples of these types of deposits include the mines in the Bathurst region of New Brunswick. Skarn deposits are formed at or near the contact between a typically carbonate-rich host rock with an igneous intrusion. Variations in the type of igneous intrusion result in variations in the mineralization that follows. An example of a lead-zinc skarn is the Sa Dena Hes deposit near Watson Lake, Yukon.

HEALTH AND THE ENVIRONMENT

Zinc plays an important role as a micro-nutrient in the development and health of a variety of plants and animals. In humans, zinc plays an important role in the function of more than 200 enzymes, for the stabilization of DNA and the expression of genes, and for the transfer of nervous signals.

The human body contains 2-3 g of zinc. The recommended daily zinc intake is 12 mg/day for adult women and 15 mg/day for adult men. Daily intake is not only dependent on food, but also on sex, age and general health status. Growing infants, children, adolescents, women in pregnancy, and the elderly have a higher zinc requirement. Food is the primary source of zinc for humans with only a small part coming from drinking water. The major sources of zinc in the diet are red meat, poultry, fish, seafood, whole cereals and dairy products.

PRICE OUTLOOK

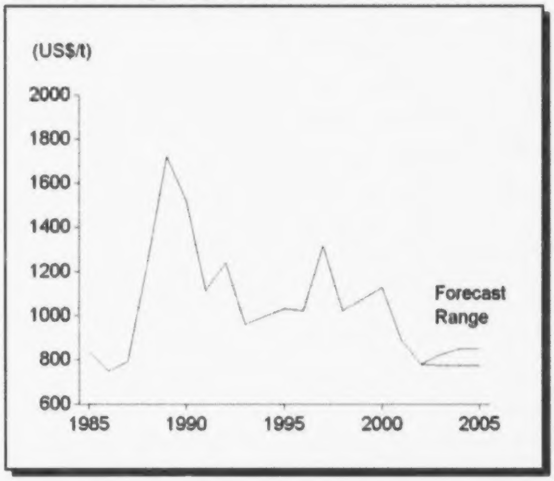
Cash settlement prices struggled throughout the year to remain above US$800/t on the London Metal Exchange (LME). Overall zinc prices followed a downward trend, reaching record lows of $725.50/t by mid-August, only to rise again briefly to US$823/t in December and finish the year at US$749.50/t. The continued low zinc prices did not, however, lead to any significant cuts in production.

While user stocks fell by about 105 000 t during the year, stocks on the LME continued their upward climb from 434 000 t in early January to over 651 000 t by the end of the year. Overall, the International Lead and Zinc Study Group forecast anticipates that the Western World market for refined zinc metal will again remain in substantial surplus in both 2002 and 2003.

Prices reflected the oversupply in the market and averaged US$779/t in 2002 and are expected to rise slightly to average about $800/t in 2003.

Beyond 2003, continued growth in galvanizing markets, combined with good growth overall for principal zinc markets, is expected in the remainder of the forecast period with zinc prices ranging from US$800 to $850/t through to 2005.

Figure 3
Zinc Prices, 1985-2005



Source: International Lead and Zinc Study Group.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of May 30, 2003. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/com_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

		Canada			United States	EU (1)	Japan
Item No.	Description	MFN	GPT	USA	Canada	MFN	WTO (2)
2603.00	Copper ores and concentrates						
2603.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2607.00	Lead ores and concentrates						
2607.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2608.00	Zinc ores and concentrates						
2608.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2616.10	Silver ores and concentrates						
2616.10.00.30	Zinc content	Free	Free	Free	Free	Free	Free
26.20	Ash and residues (other than from the manufacture of iron or steel) containing arsenic, metals, or their compounds.						
2620.11	Hard zinc spelter	Free	Free	Free	Free	Free	Free
2817.00	Zinc oxide; zinc peroxide	Free-6%	Free	Free	Free	6.6%	4.3%
28.33	Sulphates; alums; peroxosulphates (persulphates)						
2833.26	Of zinc	Free	Free	Free	Free	5.5%	3.9%
79.01	Unwrought zinc						
	Zinc, not alloyed:						
7901.11	Containing by weight 99.99% or more of zinc	Free	Free	Free	Free	2.5%	Free-4.30 yen/kg
7901.12	Containing by weight less than 99.99% of zinc	Free	Free	Free	Free	2.5%	Free-4.30 yen/kg
7901.20	Zinc alloys:						
7901.20.00.10	Containing by weight 90% or more but less than 97.5% of zinc	Free	Free	Free	Free	2.5%	Free-4.20 yen/kg
7901.20.00.20	Containing by weight less than 90% of zinc	Free	Free	Free	Free	2.5%	Free-4.20 yen/kg
7902.00	Zinc waste and scrap	Free	Free	Free	Free	Free	Free
79.03	Zinc dust, powders and flakes						
7903.10	Zinc dust	Free	Free	Free	Free	2.5%	3%
7903.90	Other:	Free	Free	Free	Free	2.5%	3%
7904.00	Zinc bars, rods, profiles and wires	Free	Free	Free	Free	5%	3%
7905.00	Zinc plates, sheets, strip and foil	Free	Free	Free	Free	5%	3%
7906.00	Zinc tubes, pipes, and tube or pipe fittings (for example, couplings, elbows, sleeves)	3%	Free	Free	Free	5%	3%
7907.00	Other articles of zinc						
7907.00.10	Anodes for electroplating	Free	Free	Free	Free	5%	3%
7907.00.20	Discs or slugs, containing by weight 90% or more of zinc; gutters, roof capping, skylight frames and other fabricated building components	3%	Free	Free	Free	5%	3%
7907.00.90	Other	3%	3%	Free	Free	5%	3%

Sources: Canadian *Customs Tariff*, effective January 2003, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2003; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (42nd Annual Edition: 2002); *Customs Tariff Schedules of Japan*, 2003.
(1) Duty suspension may apply for certain goods. (2) WTO rate is shown; lower tariff rates may apply circumstantially.
Note: Where there is a tariff "range," a complete match of the HS code was not available; therefore, the high and low for the product in question are shown.

TABLE 1. CANADA, ZINC PRODUCTION AND TRADE, 2001 AND 2002, AND USE, 1999-2001

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION					
	All forms (1)				
	New Brunswick	313 089	441 142	256 696	313 683
	Quebec	252 143	355 269	235 566	287 862
	Ontario	77 776	109 586	100 775	123 146
	Manitoba	91 782	129 321	89 198	109 000
	Saskatchewan	2 047	2 884	5 172	6 320
	British Columbia	108 855	153 377	44 885	54 849
	Nunavut	166 356	234 396	159 632	195 070
	Total	1 012 048	1 425 976	891 924	1 089 931
	Mine output (2)	1 064 744	. . .	911 624	. . .
	Refined (3)	661 172	. . .	793 475	. . .
EXPORTS					
2603.00.30	Zinc content in copper	–	–	–	–
2607.00.30	Zinc content in lead	–	–	–	–
2608.00.30	Zinc content in zinc ores and concentrates				
	Belgium	122 681	87 732	103 377	65 917
	Germany	24 365	24 100	57 649	62 121
	Japan	31 964	12 820	45 618	47 707
	Spain	67 622	53 142	61 395	40 572
	Finland	55 279	54 054	44 715	40 497
	South Korea	27 468	13 716	21 199	20 449
	Norway	25 844	26 704	18 448	14 148
	Switzerland	3 936	2 729	15 708	10 084
	Italy	18 302	14 580	8 700	9 059
	China	5 033	3 400	3 665	5 671
	Peru	–	–	7 495	4 572
	Other countries	80 718	73 438	10 916	6 903
	Total	463 212	366 415	398 885	327 700
2620.11	Ash and residues containing hard zinc spelter				
	United States	161	119	439	318
2620.19	Ash and residues containing mainly zinc, n.e.s.				
	United States	7 728	5 942	10 884	7 762
	India	256	195	139	90
	Taiwan	–	–	40	40
	Japan	21	23	41	34
	Total	8 005	6 160	11 104	7 926
2817.00	Zinc oxide; zinc peroxide				
	United States	47 548	71 160	44 782	60 902
	Belgium	20	22	740	793
	Brazil	212	277	395	546
	France	281	365	502	536
	Hong Kong	59	128	168	286
	Saint Vincent	–	–	94	142
	Other countries	1 690	2 127	193	297
	Total	49 810	74 079	46 874	63 502
2833.26	Zinc sulphate				
	United States	208	216	2 127	2 180
7901.11	Zinc, not alloyed, unwrought, containing by weight 99.99% or more of zinc				
	United States	304 103	474 988	374 128	507 762
	Taiwan	2 772	6 435	7 089	8 673
	Malaysia	1 171	1 605	5 392	7 082
	Philippines	420	566	4 867	6 331
	Italy	–	–	4 947	6 078
	Hong Kong	3 830	5 578	3 734	4 838
	Indonesia	3 920	6 164	2 674	3 630
	Singapore	1 469	2 379	1 331	1 833
	Other countries	10 584	14 831	688	917
	Total	328 269	512 546	404 850	547 144

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7901.12	Zinc, not alloyed, unwrought, containing by weight less than 99.99% of zinc				
	United States	146 162	226 649	165 910	221 224
	Hong Kong	6 550	11 451	8 985	13 238
	Indonesia	4 702	7 596	4 526	6 125
	Taiwan	308	579	3 868	5 133
	Philippines	1 793	2 924	2 753	3 652
	Malaysia	457	672	2 335	3 294
	Japan	4 493	6 914	2 194	2 972
	Singapore	416	611	1 124	1 528
	Other countries	2 034	5 840	1 705	2 453
	Total	166 915	263 238	193 400	259 619
7901.20	Zinc alloys, unwrought				
	United States	1 823	2 709	501	866
	Trinidad and Tobago	–	–	2	5
	Total	1 823	2 709	503	871
7902.00	Zinc waste and scrap				
	United States	37 446	16 844	28 935	13 178
	China	71	78	611	670
	Hong Kong	2 025	2 100	562	622
	Other countries	808	706	163	107
	Total	40 350	19 728	30 271	14 577
7903.10	Zinc dust				
	United States	6 086	13 769	6 224	13 112
	Other countries	19	31	57	134
	Total	6 105	13 800	6 281	13 246
7903.90	Zinc powders and flakes				
	United States	8 016	19 463	10 863	24 423
	Other countries	763	1 103	549	832
	Total	8 779	20 566	11 412	25 255
7904.00	Zinc bars, rods, profiles and wire				
	United States	190	1 058	160	1 079
	Other countries	2	6	7	20
	Total	192	1 064	167	1 099
7905.00	Zinc plates, sheets, strip and foil				
	United States	6	64	46	203
	South Korea	–	–	10	46
	Germany	–	–	8	30
	France	32	174	–	–
	Total	38	238	64	279
7906.00	Zinc tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves)				
	United States	1 097	8 509	831	5 244
	Other countries	–	–	5	17
	Total	1 097	8 509	836	5 261
7907.00	Other articles of zinc				
	United States	2 597	22 977	2 925	25 786
	Spain	–	–	134	820
	Sweden	–	–	21	102
	Other countries	118	432	129	203
	Total	2 715	23 409	3 209	27 001
	Total exports	1 077 679	1 312 796	1 110 422	1 295 978

TABLE 1 (cont'd)

Item No.		2001		2002 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS					
2603.00.00.30	Zinc content in copper ores and concentrates	–	–	2	2
2607.00.00.30	Zinc content in lead ores and concentrates	5 031	4 904	2 637	2 882
2608.00.00.30	Zinc content in zinc ores and concentrates	140 465	91 534	276 053	127 658
2616.10.00.30	Silver ores and concentrates	8 514	6 494	–	–
2620.11	Ash and residues containing hard zinc spelter	–	–	–	–
2620.19	Ash and residues containing mainly zinc, n.e.s.	572	338	537	507
2817.00	Zinc oxide; zinc peroxide	11 264	15 237	10 463	13 126
2833.26	Zinc sulphate	6 245	4 426	4 441	3 089
7901.11	Zinc, not alloyed, unwrought, containing by weight 99.99% or more of zinc	6 121	8 990	5 027	7 004
7901.12	Zinc, not alloyed, unwrought, containing by weight less than 99.99% of zinc	347	509	91	124
7901.20	Zinc alloys, unwrought	4 844	9 562	4 353	7 457
7902.00	Zinc waste and scrap	302	244	343	315
7903.10	Zinc dust	5 536	10 388	6 170	10 727
7903.90	Zinc powders and flakes	428	723	536	729
7904.00	Zinc bars, rods, profiles and wire	2 618	5 275	1 706	2 507
7905.00	Zinc plates, sheets, strip and foil	1 691	6 186	1 210	4 459
7906.00	Zinc tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves)	1 149	8 222	972	6 212
7907.00	Other articles of zinc	4 897	19 195	5 330	20 731
	Total imports	200 044	192 227	319 068	207 529

	1999			2000 (a)			2001 (p) (a)		
	Primary	**Recycled**	**Total**	**Primary**	**Recycled**	**Total**	**Primary**	**Recycled**	**Total**
					(tonnes)				
QUANTITY USED (5) (6)									
Zinc used for or in the production of:									
Copper alloys (brass, bronze, etc.)	x	x	2 395	x	x	2 647	x	x	2 412
Galvanizing: electro	x	x	2 472	x	x	2 335	x	x	2 018
hot dip	x	x	75 716	x	x	73 568	x	x	72 676
Zinc die-cast alloys	x	x	29 550	x	x	31 105	x	x	26 632
Other products (including rolled and ribbon zinc, zinc oxides, electroplating)	x	x	33055	x	x	38057	x	x	40819
Total	142 451	737	143 188	136 544	11 369	147 913	143 431	1 125	144 556
User stocks, year-end	12 175	89	12 264	7 834	938	8 772	9 814	375	10 189

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; n.e.s. Not elsewhere specified; (p) Preliminary; x Confidential.
(a) Increase in number of companies being surveyed.
(1) New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export. (2) Zinc content of ores and concentrates produced. (3) Refined zinc produced from domestic and imported ores. (4) Includes HS classes 2603.00.30, 2607.00.30 and 2616.10.30. (5) User survey does not represent all Canadian users and is therefore consistently less than the apparent quantity used. (6) Due to confidentiality in some end-use categories, a breakdown of primary and recycled sources is not provided in order to be consistent.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, ZINC PRODUCTION AND EXPORTS,[1] 1975, 1980 AND 1986-2002

	Production		Exports		
	All Forms (2)	Refined (3)	In Ores and Concentrates	Refined	Total
			(tonnes)		
1975	1 055 151	426 902	705 088	247 474	952 562
1980	883 697	591 565	434 178	471 949	906 127
1986	988 173	570 981	450 249	427 176	877 425
1987	1 157 936	609 909	613 185	441 227	1 054 412
1988	1 370 000	703 206	816 885	551 521	1 368 406
1989	1 272 854	669 677	614 223	495 061	1 109 284
1990	1 179 372	591 786	716 185	452 251	1 168 436
1991	1 083 008	660 552	566 815	520 508	1 087 323
1992	1 195 736	671 702	678 172	509 744	1 187 916
1993	990 727	659 881	455 953	493 264	949 217
1994	976 309	690 965	450 320	551 168	1 001 488
1995	1 094 703	720 346	609 575	533 179	1 142 754
1996	1 162 720	716 467	670 789	581 604	1 252 393
1997	1 026 864	703 798	489 697	546 964	1 036 661
1998	991 584	745 131	425 341	576 926	1 002 267
1999	963 321	776 927	327 662	610 793	938 455
2000	935 713	779 892	326 907	602 626	929 533
2001	1 012 048	661 172	463 212	495 184	958 396
2002 (p)	891 924	793 475	398 885	598 250	997 135

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary.
(1) Beginning in 1988, exports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2608.00.30, 2603.00.30, 2607.00.30 and 2616.10.30. Refined production includes HS classes 7901.11 and 7901.12. (2) New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export. (3) Refined zinc produced from domestic and imported ores.

TABLE 3. WESTERN WORLD PRIMARY ZINC STATISTICS, 1998-2002

	1998	1999	2000	2001	2002 (p)
			(000 tonnes)		
Mine production (zinc content)	5 694	5 897	6 314	6 600	6 548
Metal production	5 713	5 832	6 138	6 275	6 623
Metal used	6 531	6 827	7 134	6 911	7 035

Source: International Lead and Zinc Study Group.
(p) Preliminary.

TABLE 4. WORLD MINE PRODUCTION OF ZINC, 1998-2002

	1998	1999	2000	2001	2002 (p)
			(000 tonnes)		
EUROPE					
Finland	31	20	16	20	35
Ireland	180	200	263	298	253
Poland	158	155	157	153	140
Russia	114	161	163	164	162
Spain	128	154	204	161	70
Sweden	161	175	177	159	158
Others	104	82	83	98	100
Subtotal	880	947	1 063	1 053	918
AFRICA					
Morocco	112	112	105	89	84
Namibia	42	35	40	38	41
South Africa	70	70	63	62	58
Others	33	51	48	48	46
Subtotal	257	268	256	237	229
OCEANIA					
Australia	1 020	1 110	1 379	1 476	1 444
AMERICAS					
Bolivia	151	145	149	145	148
Brazil	88	96	93	93	121
Canada	1 062	1 021	1002	1 065	916
Mexico	395	363	393	429	495
Peru	869	900	910	1 056	1 233
United States	755	852	852	842	783
Others	88	106	110	120	119
Subtotal	3 408	3 483	3 509	3 750	3 815
ASIA					
China	1 273	1 476	1 780	1 572	1 499
India	195	185	208	222	248
Iran	86	98	102	105	121
Japan	68	64	64	45	43
Kazakhstan	224	283	322	320	376
North Korea	44	37	34	28	28
Thailand	25	24	27	24	25
Turkey	58	57	48	36	43
Others	32	34	38	42	40
Subtotal	2 005	2 258	2 623	2 394	2 423
Total world	7 569	8 065	8 830	8 910	8 829
Total Western World	5 694	5 891	6 314	6 600	6 548

Source: International Lead and Zinc Study Group.
(p) Preliminary.

TABLE 5. WORLD ZINC METAL PRODUCTION,(1) 1998-2002

	1998	1999	2000	2001	2002 (p)
			(000 tonnes)		
EUROPE					
Belgium	205	232	264	256	239
Finland	199	225	223	249	249
France	320	318	318	329	334
Germany	361	361	357	357	378
Italy	232	145	170	179	176
Netherlands	217	221	217	206	203
Norway	138	144	138	145	145
Poland	175	179	173	175	160
Russia	197	232	242	250	257
Spain	385	383	391	443	512
Others	262	252	277	291	270
Subtotal	2 691	2 692	2 770	2 880	2 923
AFRICA					
Algeria	27	27	26	26	24
South Africa	108	108	103	109	112
Others	–	–	–	–	2
Subtotal	135	135	129	135	138
AMERICAS					
Argentina	39	40	36	40	39
Brazil	177	187	192	193	255
Canada	745	777	780	661	793
Mexico	229	219	233	300	312
Peru	184	191	200	190	171
United States	368	372	371	329	289
Subtotal	1 741	1 785	1 812	1 713	1 859
ASIA					
China	1 486	1 703	1 957	2 078	2 106
India	180	189	204	234	246
Japan	608	633	654	644	640
Kazakhstan	240	243	262	277	285
South Korea	390	430	477	508	608
Thailand	89	95	101	105	105
Others	150	119	119	131	142
Subtotal	3 143	3 412	3 774	3 977	4 132
OCEANIA					
Australia	311	344	494	556	567
Total world	8 021	8 369	8 979	9 261	9 619
Total Western World	5 713	5 832	6 138	6 275	6 623

Source: International Lead and Zinc Study Group.

– Nil; (p) Preliminary.

(1) Total production by smelters and refineries of zinc in marketable form or used directly for alloying, including production on toll in the reporting country, regardless of the type of source material from which it is produced, i.e., whether ores, concentrates, residues, slag or scrap. Remelted zinc and zinc dusts are excluded.

TABLE 6. ZINC USE,[1] BY COUNTRY AND BY REGION, 1998-2002

	1998	1999	2000	2001	2002 (p)
	(000 tonnes)				
EUROPE					
Belgium	260	367	383	374	352
France	285	300	311	327	318
Germany	573	561	532	549	512
Italy	373	336	385	348	374
Russia	111	120	137	150	153
Spain	197	190	203	228	226
United Kingdom	219	220	210	191	185
Others	632	621	662	655	660
Subtotal	2 650	2 715	2 823	2 822	2 780
AFRICA					
South Africa	91	87	92	89	92
Others	62	70	78	76	79
Subtotal	153	157	170	165	171
OCEANIA					
Australia	192	210	217	222	223
New Zealand	17	15	14	16	17
Subtotal	209	226	231	238	240
AMERICAS					
Brazil	177	179	188	198	216
Canada	170	169	176	180	192
Mexico	186	200	212	210	225
United States	1 307	1 342	1 348	1 181	1 168
Others	157	168	181	173	173
Subtotal	1 997	2 058	2 105	1 942	1 974
ASIA					
China	920	1 200	1 350	1 500	1 650
India	232	254	270	286	310
Japan	659	634	676	633	603
South Korea	318	389	438	401	476
Taiwan	241	273	294	276	302
Others	532	590	644	669	699
Subtotal	2 902	3 340	3 672	3 765	4 040
Total world	7 911	8 496	9 000	8 931	9 205
Total Western World	6 531	6 827	7 134	6 911	7 035

Source: International Lead and Zinc Study Group.

(p) Preliminary.

(1) Total refined zinc use, including zinc used directly for the production of zinc alloys, regardless of the type of source material from which it is produced, i.e., ores, concentrates, residues, slags or scrap. Remelted zinc and zinc dusts are excluded.

TABLE 7. CANADA, ZINC METAL CAPACITY, 2002

Company and Location	Annual Rated Capacity
	(000 tonnes of slab zinc)
PRIMARY	
Canadian Electrolytic Zinc Limited Valleyfield, Quebec	260
Falconbridge Limited Timmins, Ontario	145
Hudson Bay Mining and Smelting Co., Limited Flin Flon, Manitoba	115
Teck Cominco Ltd. Trail, British Columbia	290
Total primary, Canada	810

Source: Natural Resources Canada.

TABLE 8. MONTHLY AVERAGE ZINC PRICES, 2001 AND 2002

	LME Special High Grade Settlement
	(US$/t)
2001	
January	1 033.4
February	1 020.9
March	1 004.7
April	969.5
May	937.9
June	894.9
July	852.4
August	828.1
September	798.6
October	761.5
November	772.9
December	754.7
Yearly average	886.3
2002	
January	793.2
February	771.3
March	819.3
April	808.2
May	769.6
June	767.1
July	794.8
August	747.6
September	756.2
October	754.7
November	765.3
December	797.8
Yearly average	778.6

Source: International Lead and Zinc Study Group.

Statistical Report

This statistical summary of the Canadian mineral industry has been compiled by staff of the Minerals and Mining Statistics Division, Minerals and Metals Sector, Natural Resources Canada (NRCan), under the general direction of Yvan Gauthier, Director.

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Statistics contained in this summary are obtained from a variety of sources. Principal sources include the statistical survey programs of NRCan and Statistics Canada. The statistical survey program of the Minerals and Mining Statistics Division of NRCan is conducted jointly with the provincial/territorial governments and Statistics Canada in order to minimize the reporting burden on the mineral industry. The cooperation of the companies providing information is greatly appreciated.

*(**Note to Reader:** We continue to review the tables of this Report in order to establish the requirements of users. We would appreciate your feedback on which tables are important to you. Please contact Laurie Morrison at tel. (613) 992-6767 or e-mail lmorriso@nrcan.gc.ca to provide your input.)*

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TABLE 1. MINERAL PRODUCTION OF CANADA, 1999-2002

	Unit	1999		2000		2001		2002	
	(000)	(quantity)	($000)	(quantity)	($000)	(quantity)	($000)	(quantity)	($000)
METALS									
Antimony	kg	357	733	364	781	234	518	143	395
Bismuth	kg	217	2 402	202	2 343	258	3 176	189	1 905
Cadmium	kg	1 115	647	934	501	979	744	896	795
Calcium	kg	x	x	x	x	x	x	x	x
Cesium, pollucite	kg	x	x	x	x	x	x	x	x
Cobalt	kg	2 014	112 285	2 022	100 372	2 112	80 988	2 027	49 036
Columbium (niobium)	kg	2 313	x	2 183	x	2 911	x	3 400	x
Copper	kg	581 582	1 366 138	621 888	1 684 075	614 311	1 535 165	577 032	1 418 923
Germanium	kg	x	x	x	x	x	x	x	x
Gold	g	157 617	2 099 302	153 715	2 044 869	158 874	2 135 275	147 866	2 292 370
Ilmenite	t	x	x	x	x	x	x	x	x
Indium	g	x	x	x	x	x	[illegible]	x	x
Iron ore	t	33 789	1 303 667	35 247	1 424 448	27 119	1 188 928	30 969	1 391 692
Iron, remelt	t	x	x	x	x	x	x	x	x
Lead	kg	155 369	115 905	143 303	96 586	150 389	109 483	99 056	70 726
Lithium	kg	x	x	x	x	x	x	x	x
Magnesium	kg	x	x	x	x	x	x	x	x
Molybdenum	kg	6 250	59 558	6 980	62 736	8 556	73 845	7 521	x
Nickel	kg	176 749	1 591 805	181 138	2 323 827	184 300	1 777 389	178 338	1 883 250
Platinum group	g	13 872	250 466	15 304	478 460	20 694	651 923	21 829	449 509
Selenium	kg	359	2 677	335	4 053	238	2 861	226	3 114
Silver	kg	1 174	294 516	1 169	278 966	1 265	277 916	1 344	314 500
Tantalum	kg	66	9 304	70	10 030	94	13 616	71	7 731
Tellurium	kg	64	710	53	341	51	208	45	281
Uranium	kg	10 157	525 873	9 921	473 231	12 991	605 400	13 056	608 406
Zinc	kg	963 320	1 540 350	935 713	1 567 320	1 012 047	1 425 976	891 923	1 089 931
Total metals		..	9 703 890	..	10 980 027	..	10 359 338	..	10 225 056
NONMETALS									
Asbestos	t	337	161 000	310	141 670	277	118 741	240	98 000
Barite	t	67	6 900	21	4 659	23	4 685	13	2 872
Cement	t	12 625	1 230 972	12 612	1 258 697	12 986	1 348 313	13 201	1 387 497
Clay products		22	164 718	29	175 380	27	194 580	27	235 189
Diamonds	carats	2 429	606 254	2 435	624 949	3 716	717 780	4 984	801 469
Gemstones	kg	218	602	221	1 224	148	3 047	348	5 622
Graphite	t	x	x	x	x	x	x	x	x
Gypsum	t	9 345	106 634	8 572	105 655	7 821	95 965	8 847	112 745
Lime	t	2 565	238 893	2 525	237 601	2 213	213 831	2 237	220 463
Magnesitic dolomite	t	x	x	x	x	x	x	x	x
Marl	t	x	x	x	x	x	x	x	x
Mica	t	x	x	x	x	x	x	x	x
Nepheline syenite	t	676	57 400	717	62 376	710	65 519	724	67 882
Peat	t	1 253	181 903	1 277	173 958	1 319	186 381	1 301	190 094
Phosphates	t	x	x	x	x	x	x	x	x
Potash	t	8 475	1 634 041	9 033	1 644 196	8 237	1 617 433	8 189	1 597 763
Potassium sulphate	t	x	x	x	x	x	x	x	x
Pumice	t	x	x	x	x	x	x	x	x
Quartz	t	1 461	39 415	1 508	41 239	1 613	44 725	1 556	43 534
Salt	t	12 686	373 619	12 164	352 108	13 725	426 082	12 313	412 096
Sand and gravel	t	243 251	960 785	238 901	971 159	236 486	1 062 234	229 535	1 047 388
Serpentine	t	x	x	x	x	x	x	x	x
Soapstone, talc and pyrophyllite	t	79	21 108	85	25 476	45	15 228	84	22 935
Sodium sulphate	t	x	x	x	x	x	x	x	x
Stone	t	109 184	775 499	118 334	882 343	124 758	957 048	119 113	971 822
Sulphur in smelter gas	t	843	57 851	831	56 643	762	33 772	751	46 135
Sulphur, elemental	t	8 656	96 969	8 621	92 411	8 154	1 277	7 787	563
Titanium dioxide	t	x	x	x	x	x	x	x	x
Tremolite	t	x	x	x	x	x	x	x	x
Wollastonite	t	x	x	x	x	x	x	x	x
Zeolite	t	x	x	x	x	x	x	x	x
Total nonmetals		..	7 332 909	..	7 427 529	..	7 617 190	..	7 751 825
MINERAL FUELS									
Coal	t	72 497	1 474 495	69 163	1 427 366	70 354	1 557 115	66 822	1 593 091
Natural gas	000 m^3	162 218	14 192 201	167 790	27 827 727	171 388	33 677 530	171 348	23 295 853
Natural gas by-products	m^3	28 805	2 534 713	30 543	5 660 657	29 321	4 575 283	29 542	3 290 828
Petroleum	m^3	122 247	18 698 282	127 809	30 523 595	129 810	25 181 363	137 356	30 794 486
Total fuels		..	36 899 691	..	65 439 345	..	64 991 291	..	58 974 258
Total all minerals		..	53 936 491	..	83 846 901	..	82 967 819	..	76 951 139

Sources: Natural Resources Canada; Statistics Canada.

. . Not available; x Confidential.

Notes: Numbers may not add to totals due to rounding. Confidential values are included in totals.

TABLE 2. CANADA, VALUE OF MINERAL PRODUCTION, PER CAPITA VALUE OF MINERAL PRODUCTION, AND POPULATION, 1973-2002

	Value of Mineral Production					
Year	Metals	Nonmetals (Including Structural Materials)	Fuels	Total	Per Capita Value of Mineral Production	Population of Canada
		($ millions)			($)	(000)
1973	3 947	1 293	3 227	8 467	375.31	22 560
1974	4 934	1 731	5 202	11 867	518.78	22 875
1975	5 022	1 898	6 653	13 574	584.86	23 209
1976	5 344	2 273	8 109	15 726	668.68	23 518
1977	6 031	2 612	9 873	18 516	778.11	23 796
1978	5 746	2 989	11 578	20 313	845.11	24 036
1979	8 006	3 516	15 117	26 638	1 097.25	24 277
1980	9 777	4 155	17 944	31 875	1 296.10	24 593
1981	8 841	4 491	19 046	32 378	1 300.32	24 900
1982	6 953	3 841	23 038	33 831	1 342.39	25 202
1983	7 528	3 857	27 154	38 539	1 513.95	25 456
1984	8 897	4 493	30 399	43 789	1 703.72	25 702
1985	8 745	4 864	31 120	44 730	1 724.23	25 942
1986	8 819	4 864	18 763	32 446	1 238.21	26 204
1987	10 962	5 125	20 274	36 361	1 369.53	26 550
1988	13 608	5 574	17 773	36 955	1 374.05	26 895
1989	13 982	5 566	19 785	39 333	1 436.61	27 379
1990	12 500	5 289	22 990	40 778	1 467.31	27 791
1991	10 462	4 783	19 945	35 190	1 251.42	28 120
1992	10 210	4 473	20 901	35 584	1 246.72	28 542
1993	8 871	4 459	23 214	36 545	1 262.48	28 947
1994	9 750	5 192	26 243	41 185	1 418.41	29 036
1995	12 173	5 436	25 759	43 367	1 477.38	29 354
1996	11 697	5 408	32 581	49 687	1 674.54	29 672
1997	11 549	5 912	33 077	50 538	1 685.33	29 987
1998	10 429	6 527	27 361	44 318	1 465.20	30 247
1999	9 704	7 333	36 900	53 936	1 768.92	30 491
2000	10 980	7 428	65 439	83 847	2 726.73	30 750
2001	10 359	7 617	64 991	82 968	2 683.22	30 921
2002 (p)	10 225	7 752	58 974	76 951	2 463.22	31 240

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary.
Notes: Beginning in 1986, bentonite, diatomite and sodium antimonate are reported in industrial minerals. Numbers may not add to totals due to rounding.

TABLE 3. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE, TERRITORY AND MINERAL CLASS, 2002(p)

Province/Territory	Metals		Nonmetals		Mineral Fuels		Total	
	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)
Newfoundland and Labrador	918 429	9.0	48 156	0.6	4 086 031	6.9	5 052 616	6.6
Prince Edward Island	–	–	3 521	. . .	–	–	3 521	. . .
Nova Scotia	–	–	247 443	3.2	1 062 971	1.8	1 310 414	1.7
New Brunswick	440 923	4.3	189 274	2.4	22 088	0.0	652 285	0.8
Quebec	2 349 316	23.0	1 342 222	17.3	–	–	3 691 538	4.8
Ontario	3 518 124	34.4	2 234 611	28.8	106 270	0.2	5 859 005	7.6
Manitoba	734 005	7.2	95 387	1.2	152 639	0.3	982 031	1.3
Saskatchewan	662 754	6.5	1 640 886	21.2	5 642 656	9.6	7 946 295	10.3
Alberta	600	. . .	593 562	7.7	42 021 762	71.3	42 615 924	55.4
British Columbia	1 248 058	12.2	541 896	7.0	5 438 757	9.2	7 228 711	9.4
Yukon	31 414	0.3	3 635	. . .	43 884	0.1	78 933	0.1
Northwest Territories	52 676	0.5	811 231	10.5	397 201	0.7	1 261 108	1.6
Nunavut	268 758	2.6	–	–		–	268 758	0.4
Total	10 225 056	100.0	7 751 825	100.0	58 974 258	100.0	76 951 139	100.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE AND TERRITORY, 1995-2002

Province/Territory	1995	1996	1997	1998	1999 (r)	2000	2001	2002 (p)
				($ millions)				
Alberta	20 676	26 218	26 671	21 886	29 230	49 967	49 308	42 615
Saskatchewan	4 580	5 331	5 508	4 796	5 997	8 415	7 734	7 946
British Columbia	4 501	4 340	4 681	4 466	4 538	7 901	8 623	7 229
Ontario	5 825	5 718	5 615	5 044	5 222	5 867	5 769	5 859
Newfoundland and Labrador	878	906	1 038	1 539	1 818	3 170	2 901	5 053
Quebec	3 338	3 415	3 437	3 560	3 657	3 653	3 603	3 692
Nova Scotia	560	593	481	453	380	1 193	1 411	1 310
Northwest Territories	766	781	799	585	893	1 165	1 323	1 261
Manitoba	1 022	1 002	1 126	967	907	1 234	1 023	982
New Brunswick	1 021	955	953	863	851	773	807	652
Nunavut	n.a.	n.a.	n.a.	n.a.	349	385	321	269
Yukon	196	426	225	150	89	118	139	79
Prince Edward Island	4	4	3	6	7	5	4	4
Total	43 367	49 687	50 538	44 318	53 936	83 847	82 968	76 951

Sources: Natural Resources Canada; Statistics Canada.
n.a. Not applicable; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 5. CANADA'S WORLD ROLE AS A PRODUCER OF CERTAIN IMPORTANT MINERALS, 2001^(p)

			Rank of Five Leading Countries				
		World	1	2	3	4	5
			Canada	Australia	Niger	Uzbekistan	Namibia
Uranium (U concentrates) (mine production)	t	35 610	12 487	7 680	2 920	2 400	2 239
	% of world total		**35.1**	21.6	8.2	6.7	6.3
			Canada	Russia	Belarus	Germany	Israel
Potash (K_2O equivalent) (mine production)	000 t	25 829	**8 181**	4 258	3 687	3 551	1 774
	% of world total		**31.7**	16.5	14.3	13.7	6.9
			Australia	South Africa	**Canada**	Norway	Ukraine
Titanium concentrate	000 t	5 010	1 375	1 070	**950**	338	308
	% of world total		27.4	21.4	**19.0**	6.7	6.1
			Russia	Australia	**Canada**	New Caledonia	Indonesia
Nickel (mine production)	000 t	1 235	235	199	**194**	118	102
	% of world total		19.0	16.1	**15.7**	9.5	8.3
			Russia	China	**Canada**	Kazakhstan	Brazil
Asbestos (mine production)	000 t	1 972	750	360	**262**	235	170
	% of world total		38.0	18.3	**13.3**	11.9	8.6
			China	Australia	**Canada**	Peru	United States
Zinc (mine production)	000 t	8 970	1 572	1 518	**1 065**	1 057	842
	% of world total		17.5	16.9	**11.9**	11.8	9.4
			Zambia	Russia	**Canada**	Brazil	Cuba
Cobalt (shipments)	t	34 927	7 000	5 000	**4 063**	4 000	3 910
	% of world total		20.0	14.3	**11.6**	11.5	11.2
			United States	Iran	**Canada**	Mexico	Spain
Gypsum (mine production)	000 t	103 847	16 300	11 000	**8 407**	7 500	7 500
	% of world total		15.7	10.6	**8.1**	7.2	7.2
			South Africa	Russia	**Canada**	United States	Japan
Platinum group metals (mine production)	kg	415 091	229 908	140 500	**21 783**	15 710	5 380
	% of world total		55.4	33.8	**5.2**	3.8	1.3
			China	Russia	United States	**Canada**	Australia
Aluminum (primary metal)	000 t	24 512	3 452	3 302	2 637	**2 583**	1 784
	% of world total		14.0	13.5	10.8	**10.5**	7.3
			Japan	China	South Korea	**Canada**	Mexico
Cadmium (refined production)	t	17 911	2 460	2 400	1 879	**1 493**	1 421
	% of world total		13.7	13.4	10.5	**8.3**	7.9
			United States	Chile	China	**Canada**	Peru
Molybdenum (Mo content) (mine production)	t	133 933	38 300	35 000	28 900	**8 233**	7 200
	% of world total		28.6	25.1	21.6	**6.1**	5.4
			South Africa	United States	Australia	China	**Canada**
Gold (mine production)	t	2 567 938	402 177	335 000	280 080	216 800	**160 200**
	% of world total		15.7	13.0	10.9	8.4	**6.2**
			United States	China	Germany	India	**Canada**
Salt (mine production)	000 t	226 193	44 800	31 000	15 700	14 500	**13 693**
	% of world total		19.8	13.7	6.9	6.4	**6.1**
			Australia	China	United States	Peru	**Canada**
Lead (mine production)	000 t	3 005	714	599	466	290	**154**
	% of world total		23.8	19.9	15.5	9.7	**5.1**

Sources: Natural Resources Canada, from *World Nonferrous Metal Statistics* and the *Canadian Minerals Yearbook*; U.S. Geological Survey.
(p) Preliminary.

TABLE 6. CANADA, GROSS DOMESTIC PRODUCT OF INDUSTRIAL PRODUCTION, MINING AND MINERAL MANUFACTURING AT BASIC PRICES IN CHAINED (1997) DOLLARS, 1997-2002

	1997	1998	1999	2000	2001	2002
			($ millions)			
Total industrial production (1)	202 894	210 079	223 124	239 198	233 768	239 278
Total mining and oil and gas extraction (2)	37 968	38 212	37 802	38 932	39 758	39 014
METALS						
Iron ore mining	647	624	562	771	631	617
Gold and silver ore mining	1 301	1 442	1 301	1 276	1 330	1 291
Copper, nickel, lead and zinc mining	2 662	2 801	2 735	2 684	2 749	2 581
Other metal ore mining	417	401	503	674	792	742
MINERAL FUELS						
Oil and gas extraction	21 203	21 947	22 058	20 981	21 293	22 060
NONMETALS						
Miscellaneous nonmetals (including asbestos) mining	362	380	767	598	772	976
Potash mining	1 038	957	992	1 027	909	952
Salt mining	243	219	210	217	254	232
Coal mining	1 209	1 185	1 166	1 242	1 278	1 131
Quarries and sand pits	821	852	892	948	994	1 001
SUPPORT ACTIVITIES FOR MINING AND OIL AND GAS EXTRACTION	4 032	3 761	3 345	4 528	4 708	3 685
MINERAL MANUFACTURING						
Primary metals	9 586	10 365	10 681	11 484	11 352	11 833
Nonmetallic mineral products	3 787	4 121	4 152	4 689	4 741	5 057
Fabricated metal products	9 326	9 823	10 608	13 293	13 074	13 540
Petroleum and coal products	1 657	1 805	1 737	1 716	1 781	1 836

Source: Statistics Canada, *Gross Domestic Product by Industry*, catalogue no. 15-001-XIE, September 2003.

(1) Includes mining and oil and gas extraction, manufacturing and utilities. (2) Includes metal mining, nonmetal mining (including coal mining), quarries and sand pits, crude petroleum and natural gas, and support activities.

TABLE 7. CANADA, GROSS DOMESTIC PRODUCT BY INDUSTRY AT BASIC PRICES IN CHAINED (1997) DOLLARS, 1997-2002

	1997	1998	1999	2000	2001	2002
			($ millions)			
Gross domestic product, all industries	816 801	848 414	892 870	933 713	947 039	977 576
Agriculture	12 767	13 968	15 338	14 990	13 806	12 683
Fishing, hunting and trapping	847	821	845	858	865	950
Forestry and logging	5 564	5 644	5 828	6 046	5 728	5 642
Support activities for mining, oil and gas	4 032	3 761	3 362	4 871	5 143	4 112
Mining and oil and gas extraction	37 968	38 212	37 802	38 932	39 758	39 014
Manufacturing	142 274	149 314	160 123	167 604	159 853	164 052
Construction	42 995	44 422	46 515	48 470	50 347	52 056
Transportation and warehousing	40 335	41 138	43 382	45 198	44 898	45 029
Information and culture	27 981	29 944	34 054	38 527	42 376	45 647
Electric power, gas and water utilities	26 684	26 233	26 825	28 079	27 419	27 920
Trade, wholesale	43 694	47 161	50 413	53 493	54 534	58 433
Trade, retail	42 252	44 826	46 919	49 488	51 399	54 513
Finance, insurance and real estate	155 503	160 142	168 068	174 517	180 803	186 788
Community, business and personal services	185 643	192 996	201 982	209 866	216 108	222 845
Public administration	49 482	50 043	50 893	51 885	53 672	55 042

Source: Statistics Canada.

TABLE 8. CANADA, STAGES 1 TO 4, DOMESTIC EXPORTS OF MINERALS AND MINERAL PRODUCTS BY COMMODITY, 2000-2002

	Unit of Measure	2000		2001		2002 (p)	
	(000)	(quantity)	($000)	(quantity)	($000)	(quantity)	($000)
METALS							
Aluminum	. .	. .	8 002 634	. .	8 242 895	. .	8 515 128
Antimony	kg	62	447	90	505	58 236	67 018
Bismuth	kg	281	3 038	98	1 070	92	906
Cadmium	kg	2 172	4 170	1 478	5 052	1 617	3 943
Calcium	kg	1 355	2 612	739	1 684	1 407	2 417
Chromium	kg	6 715	30 056	6 772	29 291	5 191	25 000
Cobalt	kg	5 322	237 628	387	18 484	6 554	168 679
Copper	. .	. .	2 604 826	. .	2 528 604	. .	2 213 082
Gold	. .	. .	2 588 960	. .	2 281 074	. .	2 790 659
Iron and steel	. .	. .	11 045 290	. .	10 355 653	. .	11 413 572
Iron ore	t	26 388	1 056 226	22 065	947 911	25 854	1 092 520
Lead	. .	. .	277 662	. .	238 812	. .	234 795
Magnesium and magnesium compounds	kg	123 286	232 763	111 813	200 728	140 147	289 579
Molybdenum	kg	10 681	48 704	13 447	56 243	16 148	102 204
Nickel	. .	. .	2 537 863	. .	2 249 238	. .	2 326 390
Platinum group	. .	. .	344 690	. .	354 457	. .	221 132
Silver	. .	. .	466 761	. .	449 781	. .	466 984
Tin	. .	. .	11 837	. .	9 250	. .	7 187
Titanium	kg	90 037	16 880	57 015	23 407	37 880	19 166
Uranium and thorium	. .	. .	622 537	. .	920 829	. .	918 996
Zinc	kg	1 041 821	1 670 417	1 078 033	1 312 850	1 111 388	1 296 087
Other metals	. .		6 288 081		5 624 426		5 795 697
Total metals	. .	. .	38 094 082	. .	35 852 244	. .	37 971 141
NONMETALS							
Asbestos	. .	. .	261 061	. .	246 872	. .	247 265
Barite and witherite	t	11	3 995	8	3 147	1	931
Cement	. .	. .	746 752	. .	811 332	. .	855 893
Clay and clay products	. .	. .	51 505	. .	46 175	. .	44 698
Diamonds	. .	. .	672 336	. .	782 391	. .	906 714
Graphite	. .	. .	84 431	. .	55 984	. .	65 298
Gypsum	. .	. .	286 578	. .	235 144	. .	200 347
Lime	kg	80 630	11 436	93 516	15 321	120 062	23 456
Mica	t	25	14 665	20	12 514	22	14 232
Nepheline syenite	t	377	52 130	358	51 378	434	64 322
Peat	. .	. .	330 141	. .	318 244	. .	285 201
Potash and potassium compounds	kg	15 140 910	2 428 565	13 600 003	2 221 523	13 816 000	2 386 496
Salt and sodium compounds	t	4 576	491 775	5 773	639 374	4 686	567 646
Sand and gravel	t	3 185	29 902	4 121	41 452	4 574	56 736
Silica and silica compounds	. .	. .	22 519	. .	28 675	. .	34 966
Stones	. .	. .	185 047	. .	141 543	. .	153 389
Sulphur and sulphur compounds	t	5 796	335 606	4 000	221 637	3 634	227 756
Talc, soapstone and pyrophyllite	t	59	22 885	46	20 053	69	29 128
Titanium oxides	kg	70 587	187 044	63 539	175 012	68 220	176 748
Other nonmetals	. .	. .	3 331 848	. .	3 358 107	. .	3 448 227
Total nonmetals	. .	. .	9 550 221	. .	9 425 878	. .	9 789 449
FUELS							
Coal and coke	t	32 771	1 872 673	29 863	1 985 087	25 404	1 841 828
Natural gas	000 m^3	101 145	20 555 588	108 242	25 595 364	107 673	18 359 522
Natural gas by-products	000 m^3	12	1 816 085	9	2 021 979	11	1 611 286
Petroleum	. .	. .	27 571 416	. .	24 942 079	. .	26 976 188
Other fuels	kg	209 086	300 526	227 241	310 089	276 536	352 390
Total fuels	. .	. .	52 116 288	. .	54 854 598	. .	49 141 214
Total mining domestic exports	. .	. .	99 760 591	. .	100 132 720	. .	96 901 804
Total economy domestic exports	. .	. .	385 658 811	. .	375 116 169	. .	365 207 935

Source: Natural Resources Canada; Statistics Canada.
. . Not available or not applicable; (p) Preliminary.
Note: Totals may not add due to rounding.

TABLE 9. CANADA, STAGES 1 TO 4, IMPORTS OF MINERALS AND MINERAL PRODUCTS BY COMMODITY, 2000-2002

	Unit of Measure	2000		2001		2002 (p)	
	(000)	(quantity)	($000)	(quantity)	($000)	(quantity)	($000)
METALS							
Aluminum	. .	. .	5 008 972	. .	4 838 922	. .	5 016 964
Antimony	kg	2 654	8 497	2 313	7 198	2 509	9 040
Bismuth	kg	424	2 640	319	2 399	96	1 388
Cadmium	kg	75	1 217	56	1 051	134	1 591
Calcium	kg	122 703	51 692	84 291	40 973	107 036	55 794
Chromium	kg	69 900	79 201	60 988	69 717	79 641	66 574
Cobalt	kg	1 540	49 331	1 910	41 214	1 616	24 197
Copper	. .	. .	3 349 748	. .	1 825 652	. .	1 592 726
Gold	. .	. .	954 639	. .	807 956	. .	1 000 974
Iron and steel	. .	. .	17 131 207	. .	15 047 485	. .	16 320 664
Iron ore	t	6 618	364 182	5 961	340 313	6 897	381 173
Lead	. .	. .	467 645	. .	382 047	. .	393 127
Magnesium and magnesium compounds	kg	240 149	192 757	177 967	176 408	394 331	179 621
Molybdenum	kg	5 030	38 494	3 984	33 143	5 759	53 583
Nickel	. .	. .	396 409	. .	349 951	. .	404 010
Platinum group	g	2 106 669	377 734	2 261 075	415 968	2 501 072	306 716
Silver	. .	. .	150 911	. .	153 829	. .	186 903
Tin	. .	. .	70 593	. .	56 048	. .	54 483
Titanium	kg	11 745	151 838	12 012	107 711	18 797	80 379
Uranium and thorium	. .	. .	252 757	. .	243 142	. .	236 456
Zinc	. .	. .	269 159	. .	198 249	. .	215 475
Total metals	. .	. .	41 581 816	. .	36 939 343	. .	38 671 399
NONMETALS							
Asbestos	. .	. .	103 161	. .	94 057	. .	106 360
Barite and witherite	t	58	6 679	80	9 290	60	7 130
Cement	. .	. .	233 725	. .	242 137	. .	238 807
Clay and clay products	. .	. .	976 565	. .	998 481	. .	1 115 862
Diamonds	. .	. .	523 402	. .	498 994	. .	602 644
Graphite	. .	. .	472 366	. .	428 359	. .	415 406
Gypsum	. .	. .	48 759	. .	61 555	. .	84 384
Lime	kg	62 296	8 067	94 151	11 801	70 324	9 704
Mica	t	7	12 790	7	13 601	7	15 643
Nepheline syenite	t	–	2	–	6	–	17
Peat	. .	. .	1 219	. .	1 733	. .	2 936
Potash and potassium compounds	kg	130 969	39 085	122 305	41 887	123 872	40 213
Salt and sodium compounds	t	2 269	348 004	3 034	405 558	2 249	306 855
Sand and gravel	t	2 956	17 679	2 463	15 096	2 871	10 422
Silica and silica compounds	. .	. .	217 661	. .	201 966	. .	196 411
Stones	. .	. .	138 708	. .	173 413	. .	190 514
Sulphur and sulphur compounds	t	221	24 184	226	25 530	192	23 073
Talc, soapstone and pyrophyllite	t	62	15 498	69	17 769	67	26 123
Titanium oxides	kg	98 602	261 903	89 063	237 485	99 277	250 802
Other nonmetals	. .	. .	5 174 066	. .	5 067 906	. .	4 834 963
Total nonmetals	. .	. .	8 623 523	. .	8 546 624	. .	8 486 269
FUELS							
Coal and coke	t	20 571	1 163 991	20 829	1 263 247	23 564	1 288 103
Natural gas	000 m^3	1 201	228 763	952	294 656	3 343	602 081
Natural gas by-products	000 m^3	1	146 207	–	91 552	–	70 672
Petroleum	. .	. .	17 306 657	. .	16 611 621	. .	15 393 338
Other fuels	. .	. .	537 570	. .	586 941	. .	565 027
Total fuels	. .	. .	19 363 188	. .	18 848 017	. .	17 919 221
Total mining imports	. .	. .	69 588 527	. .	64 333 984	. .	65 076 889
Total economy imports	. .	. .	356 862 357	. .	343 075 981	. .	348 671 987

Source: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; (p) Preliminary.
Note: Totals may not add due to rounding.

TABLE 10. CANADA, STAGES 1 TO 4, VALUE OF MINERALS AND MINERAL PRODUCTS, EXPORTS BY COMMODITY, BY DESTINATION, 2002

	United States	EU	Japan	Mexico	Other	Total
			($000)			
METALS						
Aluminum	7 231 438	658 075	244 725	141 224	239 666	8 515 128
Antimony	635	27	66 306	–	50	67 018
Bismuth	516	371	–	–	19	906
Cadmium	2 402	608	737	–	196	3 943
Calcium	249	1 652	250	–	266	2 417
Chromium	24 894	–	–	–	106	25 000
Cobalt	30 727	37 592	41 924	26	58 410	168 679
Copper	1 777 659	7 882	186 275	119	241 147	2 213 082
Gold	2 622 870	119 138	32 658	–	15 993	2 790 659
Iron and steel	10 839 284	155 656	13 465	114 651	290 516	11 413 572
Iron ore	248 070	575 420	17 822	–	251 208	1 092 520
Lead	194 295	21 232	125	2 619	16 524	234 795
Magnesium and magnesium compounds	206 653	69 144	1 898	–	11 884	289 579
Molybdenum	29 040	27 894	36 655	7 388	1 227	102 204
Nickel	615 716	660 846	55 118	5	994 705	2 326 390
Platinum group	60 043	160 636	454	–	–	221 132
Silver	391 083	66 578	307	–	9 016	466 984
Tin	6 529	93	92	–	473	7 187
Titanium	16 314	1 196	–	–	1 656	19 166
Uranium and thorium	470 742	287 807	33 129	1 395	125 923	918 996
Zinc	884 185	231 004	50 757	–	130 141	1 296 087
Other metals	4 842 936	368 333	265 666	20 240	298 522	5 795 697
Total metals	30 496 280	3 451 184	1 048 363	287 667	2 687 648	37 971 141
NONMETALS						
Asbestos	106 129	5 139	16 351	4 370	115 276	247 265
Barite and witherite	857	–	–	–	74	931
Cement	850 302	1 071	517	14	3 989	855 893
Clay and clay products	35 343	3 905	810	14	4 626	44 698
Diamonds	51 860	854 207	166	–	481	906 714
Graphite	61 373	1 093	71	2	2 759	65 298
Gypsum	197 742	719	55	–	1 831	200 347
Lime	23 424	1	–	–	31	23 456
Mica	11 279	774	1 795	59	325	14 232
Nepheline syenite	48 637	9 656	948	0	5 081	64 322
Peat	252 028	1 800	19 480	482	11 411	285 201
Potash and potassium compounds	1 123 110	45 154	107 060	5 662	1 105 510	2 386 496
Salt and sodium compounds	538 555	989	12 981	–	15 121	567 646
Sand and gravel	56 436	–	111	–	189	56 736
Silica and silica compounds	31 367	107	44	–	3 448	34 966
Stones	129 726	15 452	1 518	989	5 704	153 389
Sulphur and sulphur compounds	64 430	235	–	1 581	161 510	227 756
Talc, soapstone and pyrophyllite	28 988	66	67	–	7	29 128
Titanium oxides	167 272	5 831	4	–	3 641	176 748
Other nonmetals	3 282 460	50 671	11 148	16 157	87 791	3 448 227
Total nonmetals	7 061 318	996 870	173 126	29 330	1 528 805	9 789 449
FUELS						
Coal and coke	300 692	360 947	600 888	16 764	562 537	1 841 828
Natural gas	18 359 522	–	–	–	–	18 359 522
Natural gas by-products	1 611 227	–	–	–	59	1 611 286
Petroleum	26 683 576	123 760	47 484	8 141	113 227	26 976 188
Other fuels	300 550	16 138	10 713	713	24 276	352 390
Total fuels	47 255 567	500 845	659 085	25 618	700 099	49 141 214
Total mining domestic exports	84 813 165	4 948 899	1 880 574	342 615	4 916 552	96 901 804

Sources: Natural Resources Canada; Statistics Canada.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 11. CANADA, STAGES 1 TO 4, VALUE OF MINERALS AND MINERAL PRODUCTS, IMPORTS BY COMMODITY, BY ORIGIN, 2002

	United States	EU	Japan	Mexico	Other	Total
			($000)			
METALS						
Aluminum	3 603 880	248 313	16 851	15 762	1 132 156	5 016 964
Antimony	7 543	419	47	278	753	9 040
Bismuth	741	386	–	–	261	1 388
Cadmium	1 047	487	2	23	32	1 591
Calcium	44 314	6 381	111	–	4 988	55 794
Chromium	22 708	5 695	284	332	37 555	66 574
Cobalt	10 062	2 645	891	–	10 599	24 197
Copper	938 617	150 414	12 504	50 654	440 537	1 592 726
Gold	478 020	10 968	156 240	4 672	351 074	1 000 974
Iron and steel	11 054 438	1 671 530	582 959	454 959	2 556 778	16 320 664
Iron ore	378 426	1 972	18	–	757	381 173
Lead	251 622	20 061	11 900	7 895	101 649	393 127
Magnesium and magnesium compounds	99 312	6 561	781	512	72 455	179 621
Molybdenum	36 128	1 508	2	660	15 295	53 583
Nickel	149 018	61 727	28 375	4 212	160 678	404 010
Platinum group	184 279	65 158	2 418	–	54 861	306 716
Silver	78 269	17 654	875	24 913	65 192	186 903
Tin	18 456	1 840	23	260	33 904	54 483
Titanium	48 506	14 728	2 355	–	14 790	80 379
Uranium and thorium	64 949	23 826	136	–	147 545	236 456
Zinc	130 227	14 907	205	17 298	52 838	215 475
Other metals	7 936 904	996 464	297 188	914 270	1 944 736	12 089 561
Total metals	25 537 466	3 323 644	1 114 165	1 496 690	7 199 434	38 671 399
NONMETALS						
Asbestos	78 311	4 552	3 844	2 416	17 237	106 360
Barite and witherite	5 039	141	3	–	1 947	7 130
Cement	209 770	7 615	661	2 399	18 362	238 807
Clay and clay products	423 101	265 890	23 467	53 858	349 546	1 115 862
Diamonds	69 486	98 921	151	3	434 083	602 644
Graphite	308 977	41 695	28 272	1 110	35 352	415 406
Gypsum	78 137	2 673	48	2 391	1 136	84 384
Lime	9 513	169	–	–	22	9 704
Mica	11 999	1 622	377	1	1 644	15 643
Nepheline syenite	4	–	–	–	13	17
Peat	666	255	–	–	2 015	2 936
Potash and potassium compounds	33 140	3 261	75	73	3 664	40 213
Salt and sodium compounds	257 589	17 701	1 477	9 598	20 490	306 855
Sand and gravel	18 066	30	–	1	325	18 422
Silica and silica compounds	169 076	15 716	1 549	1 415	8 655	196 411
Stone	65 836	56 436	10	3 059	65 174	190 514
Sulphur and sulphur compounds	21 637	1 207	2	–	227	23 073
Talc, soapstone and pyrophyllite	22 953	2 136	276	3	753	26 123
Titanium oxides	178 715	50 331	2 050	218	19 488	250 802
Other nonmetals	3 646 572	461 279	75 230	124 553	527 329	4 834 963
Total nonmetals	5 608 586	1 031 632	137 492	201 098	1 507 461	8 486 269
FUELS						
Coal and coke	1 069 036	10 441	2 541	1 384	204 701	1 288 103
Natural gas	601 810	5	2	–	264	602 081
Natural gas by-products	68 683	1 116	7	–	866	70 672
Petroleum	2 561 926	3 834 588	6 000	275 721	8 715 103	15 393 338
Other fuels	517 828	34 188	3 808	664	8 539	565 027
Total fuels	4 819 283	3 880 338	12 358	277 769	8 929 473	17 919 221
Total mining imports	35 965 335	8 235 614	1 264 015	1 975 558	17 636 368	65 076 889

Sources: Natural Resources Canada; Statistics Canada.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 12. CANADA, APPARENT USE(1) OF SOME MINERALS AND RELATION TO PRODUCTION,(2) 1999-2001

	1999			2000			2001		
	Apparent Use	Production	Use as a Percentage of Production	Apparent Use	Production	Use as a Percentage of Production	Apparent Use	Production	Use as a Percentage of Production
	(tonnes)		(%)	(tonnes)		(%)	(tonnes)		(%)
Lime (3)	2 523 928	2 565 451	98.4	2 506 984	2 525 369	99.3	2 213 280	2 212 646	100.0
Quartz silica	(r) 1 686 108	1 564 186	(r) 107.8	(r) 1 615 920	1 617 955	(r) 99.9	1 548 310	1 612 840	96.0
Salt	(r) 10 252 945	12 685 895	(r) 80.8	(r) 9 829 377	12 164 069	(r) 80.8	10 752 663	13 724 979	78.3
Cement (4)	7 954 460	12 624 924	62.9	(r) 8 709 047	12 611 954	(r) 69.1	8 869 089	12 985 521	68.3
Iron ore	(r) 14 216 642	33 788 656	(r) 42.1	15 424 572	35 246 892	43.8	10 960 020	27 119 281	40.4
Gypsum	(r) 3 241 562	9 345 342	34.7	2 408 382	8 572 464	28.1	2 467 614	7 821 013	31.6
Asbestos	5 165	337 367	1.5	–	309 719	. .	4 585	276 790	1.7
Potash (K_2O equivalent)	–	8 475 270	. .	–	9 033 330	. .	–	8 236 662	. .

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; (r) Revised.

(1) "Apparent use" is production plus imports, less exports. (2) "Production" refers to producers' shipments. (3) "Apparent use" contains slaked lime in the trade data. (4) "Apparent use" contains clinker cement in the trade data.

TABLE 13. CANADA, REPORTED USE OF MINERALS AND RELATION TO PRODUCTION, 1999-2001

		1999			2000			2001		
	Unit of Measure	Use	Production	Use as a Percentage of Production	Use	Production	Use as a Percentage of Production	Use	Production	Use as a Percentage of Production
		(tonnes)		(%)	(tonnes)		(%)	(tonnes)		(%)
METALS										
Aluminum (1)	t	999 242	2 389 834	41.8	(r) 1 012 816	2 373 460	(r) 42.7	945 336	2 582 746	36.6
Antimony	kg	865 383	356 745	242.6	777 505	364 100	213.5	517 255	233 771	221.3
Bismuth	kg	17 066	217 135	7.9	12 553	202 228	6.2	20 272	257 553	7.9
Cadmium	kg	138 789	1 114 921	12.4	172 304	934 084	18.4	212 969	978 564	21.8
Chromium (chromite)	t	x	-	x	x	–	x	x	–	x
Cobalt	kg	129 988	2 013 897	6.5	126 715	2 022 318	6.3	94 270	2 112 415	4.5
Copper (2)	t	266 504	581 583	45.8	272 075	621 889	43.7	265 209	614 312	43.2
Lead (3)	t	92 557	155 369	59.6	81 365	143 303	56.8	56 956	150 369	37.9
Magnesium	t	(r) 34 419	x	x	(r) 40 154	x	x	44 925	x	x
Manganese ore	t	5 755	–	. .	5 928	–	. .	5 542	–	. .
Mercury	kg	x	–	x	x	–	x	5 605	–	x
Molybdenum (Mo content)	t	3 180	6 250	50.9	2 913	6 980	41.7	2 453	8 556	28.7
Nickel	t	(r) 22 527	176 749	12.7	24 976	181 139	13.8	17 735	184 300	9.6
Selenium	kg	12 447	358 759	3.5	8 747	334 689	2.6	23 082	238 069	9.7
Silver	kg	349 146	1 174 328	29.7	395 712	1 168 630	33.9	323 534	1 264 659	25.6
Tellurium	kg	x	63 945	x	x	53 228	x	x	50 602	x
Tin	t	2 791	–	. .	2 845	–	. .	2 626	–	. .
Tungsten (W content)	kg	187 483	–	. .	x	–	x	x	–	x
Zinc (3)	t	143 188	963 321	14.9	147 913	935 713	15.8	144 556	1 012 048	14.3
NONMETALS										
Barite	t	15 161	67 161	22.6	16 062	20 992	76.5	27 517	22 780	120.8
Feldspar	t	1 090	–	. .	1 186	–	. .	541	–	. .
Fluorspar	t	(r) 159 472	–	. .	(r) 181 158	–	. .	142 028	–	. .
Mica	t	3 692	x	x	3 994	x	x	3 865	x	x
Nepheline syenite	t	57 693	676 169	8.5	62 129	716 971	8.7	59 951	709 557	8.4
Phosphate rock	t	x	x	x	x	x	x	x	x	x
Potash (K_2O equivalent)	t	223 645	8 475 270	2.6	(r) 213 458	9 033 330	2.4	195 788	8 236 662	2.4
Sodium sulphate	t	109 647	x	x	(r) 123 646	x	x	119 625	x	x
Sulphur	t	772 769	9 498 810	(r) 8.1	(r) 817 899	9 451 926	(r) 8.7	791 926	8 915 707	8.9
Talc, etc.	t	75 815	79 493	95.4	78 821	84 945	92.8	80 780	45 086	179.2
MINERAL FUELS										
Coal	000 t	58 077	72 497	80.1	60 895	69 163	88.0	60 421	70 355	85.9
Crude oil (4)	000 m^3	(r) 96 947	122 247	(r) 79.3	100 564	127 809	78.7	103 076	129 810	79.4
Natural gas (5)	million m^3	45 154	162 219	27.8	(r) 52 243	167 790	(r) 31.1	47 026	171 388	27.4

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; (r) Revised; x Confidential.

(1) Use of primary and recycled aluminum and alloys, and scrap, reported by users. (2) "Use" is defined as domestic shipments of refined copper plus imports of refined copper. (3) Use of primary and recycled refined metal. (4) "Use" is defined as refinery receipts. (5) "Use" is defined as domestic sales.

Notes: Unless otherwise stated, "use" refers to the reported use of refined metals or nonmetallic minerals by users. Production of metals, in most cases, refers to production in all forms and includes the recoverable content of ores, concentrates, matte, etc., and the metal content of primary products recoverable at domestic smelters and refineries. Production of nonmetals refers to producers' shipments. For fuels, production is equivalent to actual output less waste.

TABLE 14. CANADA, DOMESTIC USE OF PRINCIPAL REFINED METALS IN RELATION TO REFINERY PRODUCTION,[1] 1995-2001

	Unit of Measure	1995	1996	1997	1998	1999	2000	2001
ALUMINUM								
Domestic use (2)	t	635 402	676 935	764 438	889 973	999 242	1 012 816	945 336
Production	t	2 171 992	2 283 212	2 327 188	2 374 118	2 389 834	2 373 460	2 582 746
Use as a percentage of production		29.3	29.6	32.8	37.5	41.8	42.7	36.6
COPPER								
Domestic use (3)	t	189 550	218 280	224 777	246 212	(r) 266 505	272 075	265 209
Production	t	572 618	559 200	560 582	562 261	548 563	551 393	567 720
Use as a percentage of production		33.1	39.0	40.1	43.8	48.6	49.3	46.7
LEAD								
Domestic use (4)	t	91 171	93 373	92 997	87 468	92 557	81 365	56 956
Production (5)	t	281 391	310 791	271 395	265 487	266 415	284 333	230 928
Use as a percentage of production		32.4	30.0	34.3	32.9	34.7	28.6	24.7
ZINC								
Domestic use (5)	t	130 735	134 787	133 553	138 424	143 188	147 913	144 556
Production	t	720 346	716 467	703 798	745 131	776 927	779 892	661 172
Use as a percentage of production		18.1	18.8	19.0	18.6	18.4	19.0	21.9

Source: Natural Resources Canada.

(r) Revised.

(1) Production of refined metal from all sources, including metal derived from recycled materials at primary refineries. (2) Use of primary and recycled aluminum and alloys, and scrap, reported by users. (3) "Use" is defined as domestic shipments of refined copper plus imports of refined copper. (4) Use of primary and recycled refined metal, reported by users. (5) Production of primary and recycled refined lead.

TABLE 15. AVERAGE ANNUAL PRICES[1] OF SELECTED METALS, 1994-2002

	Unit	1994	1995	1996	1997	1998	1999	2000	2001	2002
Aluminum, London Metal Exchange	¢/lb	66.986	81.903	68.296	72.544	61.574	61.736	70.267	66.458	61.231
Antimony, New York dealer	$/lb	1.777	2.278	1.466	0.996	0.718	0.627	0.655	0.649	0.883
Bismuth, New York dealer	$/lb	3.070	3.781	3.546	3.275	3.408	3.378	3.530	3.813	2.872
Cadmium, New York dealer	$/lb	1.144	1.839	1.238	0.513	0.286	0.177	0.164	0.223	0.292
Copper, electrolytic cathode, COMEX	¢/lb	107.052	134.717	105.872	103.580	75.077	72.111	83.971	73.687	71.672
Gold, London (2)	$/troy oz	384.009	384.162	387.696	331.096	294.160	278.825	278.600	269.984	309.97
Indium, New York dealer	$/troy oz	30.000	30.000	46.188	171.125	392.032	379.938	390.000	389.000	250.438
Lead, London Metal Exchange, cash	¢/lb	24.829	28.600	35.019	28.292	23.960	22.778	20.574	21.339	20.516
Magnesium, U.S. Spot Western Mean	¢/lb	144.744	191.894	187.236	165.759	159.238	155.229	137.229	125.406	121.281
Molbydenum, dealer, oxide	$/lb	4.501	7.412	3.606	4.175	3.313	2.591	2.498	2.313	3.668
Nickel, New York dealer, cathode	$/lb	2.919	3.901	3.501	3.221	2.179	2.750	3.987	2.825	3.095
Osmium, New York dealer	$/troy oz	400.000	399.375	392.458	391.000	366.867	350.000	350.000	350.800	350.000
Palladium, London PM fix	$/troy oz	142.631	151.229	128.079	177.951	284.678	357.902	681.100	651.676	336.814
Platinum, London PM fix	$/troy oz	404.998	424.346	397.171	395.210	372.019	376.880	544.226	546.169	539.812
Rhodium, New York dealer	$/troy oz	712.678	424.145	280.721	268.458	574.771	863.063	1 818.750	1 621.175	775.896
Ruthenium, New York dealer	$/troy oz	13.604	21.827	34.921	32.896	39.208	34.721	118.275	126.050	57.05
Selenium, New York dealer	$/lb	4.900	4.897	3.423	2.791	2.274	2.278	3.699	3.520	3.933
Silver, Handy & Harman	$/troy oz	5.284	5.192	5.183	4.892	5.534	5.250	5.003	4.414	4.625
Tantalum, tantalite ore, spot	$/lb	25.500	26.260	27.000	27.000	32.783	33.000	62.438	107.800	40.000
Tin, New York dealer	$/lb	2.549	2.945	2.890	2.644	2.613	2.545	2.549	2.156	1.947
Tungsten, U.S. spot ore	$/stu	36.750	56.402	55.000	53.333	44.021	40.000	40.000	53.600	43.000
Zinc, special high grade	¢/lb	45.255	53.235	51.109	59.697	46.453	48.805	51.150	45.163	38.643

Sources: Natural Resources Canada; *Metals Week*.

COMEX Commodities Exchange, Inc.

(1) Prices, except where noted, are in U.S. currency. (2) Average afternoon fixings of London bullion dealers.

TABLE 16. CANADIAN AVERAGE ANNUAL PRICES OF SELECTED METALS, 1994-2002

	Unit	1994	1995	1996	1997	1998	1999	2000	2001	2002
Aluminum, London Metal Exchange	$/kg	2.017	2.478	2.054	2.215	1.952	2.021	2.301	2.321	2.120
Antimony, New York dealer	$/kg	5.350	6.893	4.408	3.042	2.276	2.053	2.145	2.266	3.057
Bismuth, New York dealer	$/kg	9.243	11.441	10.663	10.000	10.805	11.059	11.588	12.617	9.943
Cadmium, New York dealer	$/kg	3.444	5.565	3.723	1.566	0.907	0.579	0.537	0.779	1.011
Copper, electrolytic cathode, COMEX	$/kg	3.223	4.076	3.184	3.163	2.380	2.361	2.749	2.573	2.481
Gold, London (1)	$/g	16.861	16.952	17.002	14.743	13.601	13.312	13.303	13.749	15.650
Iridium, New York dealer	$/g	1.317	1.324	2.026	7.620	18.126	18.139	18.623	19.811	12.645
Lead, London Metal Exchange, cash	¢/kg	54.739	63.052	77.204	62.373	52.823	50.217	45.358	47.044	71.029
Magnesium, U.S. Spot Western Mean	$/kg	4.631	5.462	5.804	5.496	5.707	5.893	5.894	4.379	4.199
Molbydenum, dealer, oxide	$/kg	13.552	22.428	10.844	12.748	10.504	8.482	8.179	8.077	12.699
Nickel, New York dealer, cathode	$/kg	8.789	11.804	10.528	9.835	6.908	9.003	13.055	9.865	10.715
Osmium, New York dealer	$/g	17.563	17.623	17.211	17.411	16.962	16.710	16.713	17.865	17.671
Palladium, London PM fix	$/g	6.263	6.673	5.617	7.924	13.162	17.087	35.523	33.188	16.995
Platinum, London PM fix	$/g	17.783	18.725	17.417	17.598	17.201	17.993	25.987	27.815	27.255
Rhodium, New York dealer	$/g	31.292	18.716	12.311	11.954	26.575	41.205	86.846	82.561	39.175
Ruthenium, New York dealer	$/g	0.597	0.963	1.531	1.465	1.813	1.658	5.648	6.419	2.880
Selenium, New York dealer	$/kg	14.753	14.818	10.293	8.522	7.210	7.458	12.112	12.292	13.617
Silver, Handy & Harman	$/kg	232.011	229.107	227.293	217.835	255.870	250.653	238.895	224.791	233.514
Tantalum, tantalite ore, spot	$/kg	76.777	79.459	81.192	82.442	103.937	108.034	204.441	376.450	138.485
Tin, New York dealer	$/kg	7.675	8.911	8.690	8.075	8.284	8.333	8.346	7.529	6.741
Tungsten, U.S. spot ore	$/mtu	49.397	76.189	73.835	72.700	62.307	58.460	58.470	83.561	63.778
Zinc, special high grade	$/kg	1.363	1.611	1.537	1.823	1.473	1.598	1.675	1.577	1.338

Sources: Natural Resources Canada; *Metals Week*.
COMEX Commodities Exchange, Inc.; mtu Metric tonne unit.
(1) Average afternoon fixings of London bullion dealers.

TABLE 17. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY,(1) 2000

		Mining Activity							Total Activity (2)		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
BY INDUSTRY											
Metals											
Gold	40	6 002	13 098	398 830	159 576	660 947	2 118 561	1 298 039	7 849	533 886	1 289 217
Silver-lead-zinc	4	1 279	3 004	81 099	35 757	544 110	958 248	378 382	2 015	135 373	379 023
Iron	4	3 680	8 335	301 202	192 669	528 292	1 599 847	878 885	4 788	395 402	868 898
Nickel-copper-zinc	18	8 399	18 853	527 916	182 078	1 549 906	5 242 179	3 510 195	11 027	741 592	3 514 468
Miscellaneous metal mines (3)	9	1 498	3 288	89 818	62 676	134 062	742 926	546 188	1 895	117 996	543 558
Total	75	20 858	46 579	1 398 864	632 756	3 417 317	10 661 762	6 611 689	27 574	1 924 249	6 595 165
Nonmetals											
Peat	74	1 472	3 240	40 695	9 705	49 632	224 334	164 997	1 828	54 274	166 079
Gypsum	9	542	1 201	24 050	8 415	22 790	110 853	79 647	657	30 085	79 433
Potash	11	2 513	5 338	165 866	189 676	210 097	1 703 174	1 303 401	3 308	234 280	1 301 982
Salt	10	986	2 169	50 005	20 583	45 087	333 653	267 983	1 388	74 496	268 190
Diamond	1	419	914	24 236	27 395	159 045	647 813	461 373	634	34 327	459 714
Stone	192	2 883	6 300	116 771	69 580	158 767	769 403	541 055	3 655	154 832	550 302
Sand and gravel	400	3 441	7 905	138 227	66 282	109 403	720 379	544 694	4 598	186 499	557 381
Shale, clay and refractory	8	172	359	8 486	3 823	9 021	71 393	58 549	235	13 299	58 330
Miscellaneous nonmetals (4)	20	1 398	3 015	65 145	44 602	64 518	290 839	181 719	1 849	93 067	180 535
Total	725	13 826	30 442	633 482	440 061	828 360	4 871 840	3 603 419	18 152	875 160	3 621 947
Mineral Fuels											
Coal	28	4 759	9 132	298 362	145 424	321 506	1 485 874	1 018 944	5 850	376 714	1 019 630
Total mineral industry	828	39 443	86 152	2 330 708	1 218 241	4 567 183	17 019 475	11 234 052	51 576	3 176 123	11 236 741
BY REGION											
Atlantic provinces	92	4 916	10 790	287 765	144 189	659 340	1 820 520	1 016 990	6 107	359 863	1 014 881
Quebec	197	7 961	17 411	460 408	265 116	964 455	2 895 457	1 665 886	10 905	659 428	1 661 315
Ontario	292	10 672	23 686	605 793	222 034	1 067 925	4 790 652	3 500 693	14 336	868 974	3 502 355
Prairie provinces	160	8 924	19 876	521 744	330 149	687 289	4 070 799	3 053 361	11 319	698 025	3 061 643
British Columbia	79	5 339	11 631	378 647	204 087	831 955	2 331 993	1 295 950	7 182	474 854	1 295 330
Yukon and Northwest Territories	8	1 131	2 759	76 350	52 665	356 218	1 110 055	701 171	1 727	114 978	701 217
Total Canada	828	39 443	86 152	2 330 708	1 218 241	4 567 183	17 019 475	11 234 052	51 576	3 176 123	11 236 741

Sources: Natural Resources Canada; Statistics Canada.

(1) Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. (2) Total activity includes sales and head offices. (3) Includes molybdenum and uranium. (4) Includes asbestos.

Notes: This table no longer includes data for the petroleum and natural gas industries. Numbers may not add to totals due to rounding.

TABLE 18. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES, 2000

		Mineral Manufacturing Activity							Total Activity (1)		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
BY INDUSTRY											
Primary metal manufacturing	643	75 515	...	3 898 204	2 266 281	20 018 482	36 236 019	14 434 982	93 531	5 044 717	14 305 628
Nonmetallic mineral product manufacturing	2 108	39 501	...	1 515 903	707 337	3 861 641	10 080 703	5 546 824	48 084	1 983 678	5 751 291
Fabricated metal product manufacturing	7 807	152 198	...	5 554 273	520 083	14 007 804	29 570 818	15 166 546	180 341	7 136 067	15 838 741
Petroleum and coal products manufacturing	220	7 124	...	431 796	626 972	29 776 864	33 918 005	3 678 216	10 924	684 613	3 781 607
Total	10 778	274 338	...	11 400 176	4 120 673	67 664 591	109 785 545	38 826 348	332 880	14 849 075	39 677 267
BY REGION											
Atlantic	436	x	x	x	x	x	x	x	x	x	x
Quebec	2 610	72 710	–	2 758 467	1 353 829	17 924 914	29 828 352	10 698 370	89 120	3 662 116	10 842 805
Ontario	4 748	141 240	–	6 369 643	1 967 063	30 186 239	51 295 543	19 541 491	169 076	8 155 361	19 964 522
Prairies	1 664	x	x	x	x	x	x	x	x	x	x
British Columbia	1 320	18 982	–	761 322	131 209	3 170 952	5 687 862	2 446 421	23 214	996 177	2 505 038
Total	10 778	274 338	–	11 400 176	4 120 673	67 664 591	109 785 545	38 826 348	332 880	14 849 075	39 677 267

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; x Confidential.
(1) Total activity includes sales and head offices.

TABLE 19. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY,[1] 1989-2000

		Mining Activity							Total Activity (2)		
		Production and Related Workers			Costs						
Year	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
1989	537	59 593	129 946	2 562 806	1 013 010	4 712 423	17 445 454	11 720 021	76 279	3 480 651	11 826 346
1990	521	55 558	121 448	2 510 817	1 061 768	4 619 245	16 158 686	10 477 673	73 156	3 391 151	10 571 448
1991	498	51 642	112 344	2 446 055	1 043 554	4 318 454	14 359 030	8 997 022	68 747	3 363 119	9 094 572
1992	469	46 819	101 065	2 278 504	960 413	4 249 868	13 705 148	8 494 868	62 257	3 136 794	8 566 223
1993	459	44 053	94 733	2 139 903	933 552	3 931 954	12 598 992	7 733 486	58 325	2 928 793	7 793 020
1994	555	44 083	95 756	2 227 756	970 304	3 938 223	13 872 653	8 964 126	56 195	3 019 806	9 059 983
1995	730	46 728	101 852	2 421 274	1 065 118	4 652 556	16 771 037	11 053 363	61 193	3 262 475	11 133 393
1996	727	45 552	99 532	2 466 512	1 129 784	4 939 053	16 568 618	10 499 781	59 566	3 306 371	10 575 169
1997	717	45 011	98 314	2 550 807	1 116 321	5 118 922	16 907 365	10 672 121	58 326	3 397 931	10 744 485
1998	708	42 554	92 746	2 437 877	1 056 510	4 920 070	16 172 637	10 196 057	55 929	3 309 255	10 254 270
1999 (r)	816	41 034	87 863	2 301 420	1 020 533	4 441 176	15 290 102	9 828 393	53 366	3 145 583	9 853 424
2000	828	39 443	86 152	2 330 708	1 218 214	4 567 183	17 019 475	11 234 052	51 576	3 176 123	11 236 741

Sources: Natural Resources Canada; Statistics Canada.
(r) Revised.
(1) Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. (2) Total activity includes sales and head offices.
Note: This table no longer includes date for the petroleum and natural gas industries.

TABLE 20. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES,[1] 1982-2000

		Mineral Manufacturing Activity							Total Activity (2)		
		Production and Related Workers			Costs						
Year	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
1982	5 687	229 518	475 378	5 333 201	1 728 740	34 241 605	50 045 037	14 497 245	321 785	8 126 238	14 823 990
1983	7 370	216 944	447 947	5 420 307	1 905 777	34 720 416	52 773 875	15 861 491	301 112	8 143 674	16 196 749
1984	7 511	223 816	470 367	5 948 626	2 125 032	37 738 117	57 207 764	17 980 271	304 309	8 719 151	18 265 131
1985	7 625	238 544	506 377	6 507 081	2 229 270	39 497 925	61 241 939	19 305 730	313 850	9 271 447	19 646 938
1986	7 841	248 039	524 184	6 829 899	2 096 145	31 806 478	54 521 641	19 788 464	319 950	9 563 918	20 124 687
1987	7 598	. .	. .	. .	2 154 276	35 570 988	59 787 220	22 189 903	333 536	10 188 110	22 733 514
1988	8 309	277 965	586 697	8 187 249	2 268 149	35 436 715	62 739 083	25 125 477	350 917	11 191 039	25 725 203
1989	8 300	288 494	606 841	8 893 139	2 341 578	38 785 940	64 981 175	24 317 984	360 004	12 014 330	29 859 105
1990	8 333	260 693	549 440	8 469 361	2 335 229	38 305 154	63 081 826	22 679 757	333 962	11 722 025	23 262 830
1991	7 820	242 783	510 984	8 226 481	2 456 144	34 628 749	58 093 646	20 169 425	309 678	11 288 852	20 698 450
1992	7 482	214 862	489 072	7 656 558	2 530 479	34 191 776	56 436 631	19 375 600	280 226	10 708 582	19 829 810
1993	7 202	211 316	381 263	7 656 373	2 641 864	35 060 212	58 685 636	21 008 722	273 767	10 688 689	21 445 279
1994	7 099	217 412	397 045	7 950 383	2 754 778	38 575 016	65 490 301	24 565 574	279 983	11 040 491	24 993 941
1995	7 151	230 185	492 240	8 537 700	2 862 100	41 112 900	71 292 500	27 936 100	293 594	11 841 500	28 766 000
1996	8 300	230 308	492 074	8 800 500	2 899 400	45 735 300	76 736 600	28 010 400	292 357	12 077 700	28 424 000
1997	8 057	256 877	540 163	9 830 200	3 110 100	48 440 400	81 124 600	29 829 800	321 152	13 447 700	30 254 500
1998	6 823	259 407	551 694	9 920 386	3 283 131	45 004 087	77 701 305	29 695 431	316 936	13 231 170	30 865 463
1999	6 319	259 468	546 696	10 171 350	3 442 897	49 963 931	84 657 218	32 353 132	318 493	13 704 920	33 964 186
2000	10 778	274 338	. . .	11 400 176	4 120 673	67 664 591	109 785 545	38 826 348	332 880	14 849 075	39 677 267

Source: Statistics Canada.
. . Not available; . . . Amount too small to be expressed.
(1) Includes the following industries: primary metals, nonmetallic mineral products, fabricated metal products, and petroleum and coal products. (2) Total activity includes sales and head offices.

TABLE 21. CANADA, CONSUMPTION OF FUEL AND ELECTRICITY IN THE NON-FUEL MINERAL INDUSTRY,[1] 2000

	Unit	Metals	Nonmetals (2)	Total
Coal	000 t	–	–	–
	$000	–	–	–
Gasoline	000 litres	17 910	23 306	41 216
	$000	10 627	12 466	23 093
Fuel oil, kerosene, diesel oil	000 litres	615 487	323 229	938 716
	$000	196 107	146 576	342 683
Liquefied petroleum gas	000 litres	139 386	13 741	153 127
	$000	37 093	3 662	40 755
Natural gas	000 m^3	89 690	743 248	832 938
	$000	12 739	132 398	145 137
Other fuels (3)	$000	38 134	584	38 718
Total value of fuels	$000	294 700	295 686	590 386
Electricity purchased	million kWh	10 035	2 889	12 924
	$000	338 056	144 375	482 431
Total value of fuels and electricity purchased, all reporting companies	$000	632 756	440 061	1 072 817

Sources: Natural Resources Canada; Statistics Canada.

– Nil.

(1) Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. (2) Includes all nonmetallic minerals, stone, sand and gravel, shale, clay and refractory minerals. (3) Includes wood, manufactured gas, steam purchased, and other miscellaneous fuels.

Notes: Numbers may not add to totals due to rounding.

TABLE 22. CANADA, COST OF FUEL AND ELECTRICITY USED IN THE NON-FUEL MINERAL INDUSTRY,[1] 1995-2000

	Unit	1995	1996	1997	1998	1999	2000
METALS							
Fuel	$000	237 376	289 723	283 375	244 801	213 351	294 700
Electricity purchased	million kWh	11 527	11 248	11 186	10 754	9 415	10 035
	$000	408 270	396 358	383 009	375 095	335 715	338 056
Total cost of fuel and electricity	$000	645 646	686 082	666 384	619 896	549 066	632 756
NONMETALS (2)							
Fuel	$000	91 148	87 173	95 245	172 842	205 392	295 686
Electricity purchased	million kWh	2 363	2 333	2 369	2 760	2 811	2 889
	$000	109 676	107 876	96 917	130 203	134 072	144 375
Total cost of fuel and electricity	$000	200 824	195 049	192 162	303 045	339 464	440 061
TOTAL NON-FUEL MINERAL INDUSTRY							
Fuel	$000	387 133	441 668	444 390	417 643	418 743	590 386
Electricity purchased	million kWh	14 270	14 016	13 981	13 514	12 226	12 924
	$000	543 219	533 507	509 277	505 298	469 787	482 431
Total cost of fuel and electricity	$000	930 353	975 176	953 667	922 941	888 530	1 072 817

Sources: Natural Resources Canada; Statistics Canada.

(1) Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. (2) Includes all nonmetallic minerals, stone, sand and gravel, shale, clay and refractory materials.

Notes: Numbers may not add to totals due to rounding. This table does not include data for the coal industry.

TABLE 23. CANADA, EMPLOYMENT IN THE MINERAL INDUSTRY, STAGE 1 – MINERAL EXTRACTION AND CONCENTRATING (TOTAL ACTIVITY),(1) 1961-2002

Year	Metal Mines	Nonmetal Mines (2)	Non-Fuel Minerals	Coal	Total
NAICS no.	2122	2123	2133, 2123	21211	2122, 2123, 21211
			(number)		
1961	58 591	16 238	74 829	10 302	85 131
1962	58 243	16 922	75 165	9 897	85 062
1963	57 119	17 347	74 466	9 828	84 294
1964	57 648	17 771	75 419	9 796	85 215
1965	60 942	18 364	79 306	9 697	89 003
1966	61 670	18 734	80 404	9 281	89 685
1967	61 728	18 856	80 584	8 981	89 565
1968	63 369	19 509	82 878	8 427	91 305
1969	60 550	20 014	80 564	7 371	87 935
1970	66 590	20 660	87 250	7 874	95 124
1971	66 012	20 433	86 445	8 069	94 514
1972	61 994	20 020	82 014	8 704	90 718
1973	66 134	20 667	86 801	7 856	94 657
1974	70 038	22 395	92 433	8 142	100 575
1975	69 161	20 085	89 246	8 416	97 662
1976	68 269	21 334	89 603	8 995	98 598
1977	67 242	21 798	89 040	9 781	98 821
1978	56 447	20 882	77 329	10 574	87 903
1979	58 960	21 462	80 422	10 269	90 691
1980	66 118	21 440	87 558	11 416	98 974
1981	68 712	20 574	89 286	11 182	100 468
1982	61 503	17 171	78 674	13 113	91 787
1983	52 194	16 573	68 767	11 646	80 413
1984	52 683	17 258	69 941	11 905	81 846
1985	48 672	16 915	65 587	12 076	77 663
1986	46 487	17 263	63 750	10 747	74 497
1987	45 496	17 919	63 415	10 406	73 821
1988	48 277	17 596	65 873	11 122	76 995
1989	49 395	17 595	66 990	11 279	78 269
1990	45 248	16 891	62 139	11 017	73 156
1991	42 092	15 838	57 930	10 817	68 747
1992	37 774	14 757	52 531	9 726	62 257
1993	34 746	14 719	49 465	8 860	58 325
1994	33 380	15 927	49 307	8 888	58 195
1995	35 181	16 948	52 129	9 063	61 192
1996	34 257	16 121	50 378	9 177	59 555
1997	33 012	16 376	49 388	8 938	58 326
1998	30 734	17 038	47 772	8 157	55 929
1999	28 527	17 781	46 308	7 058	53 366
2000	27 574	18 152	45 726	7 199	52 925
2001 (p)	26 686	17 707	44 393	6 030	50 423
2002 (f)	23 944	17 779	41 723	5 700	47 423

Sources: Natural Resources Canada; Statistics Canada.
NAICS: North American Industrial Classification System.
(f) Forecast; (p) Preliminary.
(1) Total activity includes sales and head offices. (2) Includes structural materials.

TABLE 24. CANADA, NON-FUEL MINERAL INDUSTRY EMPLOYMENT, BY STAGE, 1990-2002

Year	Stage 1	Stage 2	Stage 3	Stage 4 (a)	Total
			(number)		
1990	73 156	69 579	92 846	131 072	366 653
1991	68 747	67 075	84 981	119 686	340 489
1992	62 257	60 848	78 606	105 210	306 921
1993	58 325	58 054	75 293	101 506	293 178
1994	58 195	54 997	77 440	105 986	296 618
1995	61 192	55 518	79 519	115 594	311 823
1996	59 555	58 133	82 364	125 063	325 115
1997	58 326	58 280	82 812	135 174	334 592
1998	55 929	57 707	83 201	149 290	346 127
1999	53 366	57 514	81 943	151 460	344 283
2000	52 925	58 964	86 252	160 965	359 106
2001 (p)	50 423	53 878	85 828	169 272	359 401
2002 (f)	47 423	51 465	84 942	177 021	360 851

Sources: Natural Resources Canada; Statistics Canada.
(f) Forecast; (p) Preliminary.
(a) In 2002, employment data have been refined to better reflect the mining and mineral processing industries role in Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 25. CANADA, NUMBER OF WAGE EARNERS EMPLOYED IN THE NON-FUEL MINERAL INDUSTRY (SURFACE, UNDERGROUND AND MILL), 1993-2000

	1993	1994	1995	1996	1997	1998	1999	2000
				(number)				
METALS								
Surface	5 973	4 526	4 467	6 358	4 762	5 192	4 847	5 315
Underground	11 281	11 396	12 305	10 610	11 556	9 269	8 468	8 095
Mill	8 508	8 888	9 572	8 862	8 803	8 601	8 267	7 448
Total	25 762	24 810	26 344	25 830	25 121	23 062	21 582	20 858
NONMETALS								
Surface	4 620	5 318	6 369	6 051	6 185	6 286	6 770	7 101
Underground	2 098	2 093	1 967	1 926	1 964	2 009	2 008	1 864
Mill	4 369	4 591	4 625	4 211	4 392	4 506	4 907	4 861
Total	11 087	12 002	12 961	12 188	12 541	12 800	13 685	13 826
TOTAL NON-FUEL MINERAL INDUSTRY								
Surface	10 593	9 844	10 836	12 409	10 947	11 478	11 617	12 416
Underground	13 379	13 489	14 272	12 536	13 520	11 278	10 476	9 959
Mill	12 877	13 479	14 197	13 073	13 195	13 107	13 174	12 309
Total	36 849	36 812	39 305	38 018	37 662	35 862	35 267	34 684

Sources: Natural Resources Canada; Statistics Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 26. CANADA, MINE AND MILL WORKERS, BY SEX, EMPLOYED IN THE NON-FUEL MINERAL INDUSTRY, 2000

	Mine Workers				Mill Workers		Total	
	Underground		Surface					
	Male	Female	Male	Female	Male	Female	Male	Female
	(number)							
METALS								
Gold	3 219	24	954	45	1 693	67	5 866	136
Silver-lead-zinc	674	11	80	6	488	20	1 242	37
Iron ore	–	–	1 318	39	2 223	100	3 541	139
Nickel-copper-zinc	4 003	25	2 236	28	2 025	82	8 264	135
Miscellaneous metal mines	138	1	595	14	692	58	1425	73
Total	8 034	61	5 183	132	7 121	327	20 338	520
NONMETALS								
Peat	–	–	480	30	919	43	1 399	73
Gypsum	112	–	315	0	113	2	540	2
Potash	1 123	25	20	0	1 291	54	2 434	79
Salt	465	1	158	5	352	5	975	11
Diamond	–	–	228	10	170	11	398	21
Stone	–	–	2 110	15	740	18	2 850	33
Sand and gravel	–	–	3 067	90	281	3	3 348	93
Shale, clay and refractory minerals	–	–	49	2	121	0	170	2
Miscellaneous nonmetals	138	–	522	0	727	11	1 387	11
Total	1 838	26	6 949	152	4 714	147	13 501	325
Total non-fuel mineral industry	9 872	87	12 132	284	11 835	474	33 839	845

Sources: Natural Resources Canada; Statistics Canada.
– Nil.

TABLE 27. CANADA, LABOUR COSTS FOR METAL MINES IN RELATION TO TONNES MINED, 1998-2000

	Number of Wage Earners	Total Wages	Average Annual Wage	Tonnage of Ore Mined	Average Annual Tonnes Mined Per Wage Earner	Wage Cost Per Tonne Mined
	(no.)	($000)	($)	(000 t)	(t)	($)
1998						
Gold	4 582	319 026	69 626	36 454	7 956	8.75
Nickel-copper-zinc	7 039	434 680	61 753	102 694	14 589	4.23
Silver-lead-zinc	1 035	61 142	59 074	8 484	8 197	7.21
Iron ore	953	78 769	82 654	96 743	101 514	0.81
Miscellaneous metals	852	49 071	116 496	15 519	30 148	3.16
Total	14 461	942 688	65 188	259 893	17 972	3.63
1999						
Gold	4 465	300 154	67 224	44 799	10 033	6.70
Nickel-copper-zinc	6 338	385 682	60 852	71 829	11 333	5.37
Silver-lead-zinc	928	55 288	59 578	7 808	8 414	7.08
Iron ore	877	74 421	84 859	85 249	97 205	0.87
Miscellaneous metals	707	39 919	118 015	14 617	32 605	2.73
Total	13 315	855 465	64 248	224 302	16 846	3.81
2000						
Gold	4 242	290 550	68 494	41 802	9 854	6.95
Nickel-copper-zinc	6 292	400 666	63 679	88 710	14 099	4.52
Silver-lead-zinc	771	52 340	67 885	7 035	9 124	7.44
Iron ore	1 357	113 320	83 508	96 349	71 001	1.18
Miscellaneous metals	748	43 475	121 835	13 298	26 138	3.27
Total	13 410	900 351	67 140	247 194	18 434	3.64

Sources: Natural Resources Canada; Statistics Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 28. CANADA, PERSON-HOURS PAID FOR PRODUCTION AND RELATED WORKERS, AND TONNES OF ORE MINED AND ROCK QUARRIED IN METAL MINES AND OTHER MINERAL OPERATIONS, 1994-2000

	Unit	1994 (r)	1995 (r)	1996 (r)	1997 (r)	1998 (r)	1999	2000
METAL MINES (1)								
Ore mined	Mt	233.70	260.50	253.00	248.00	259.90	224.30	247.20
Person-hours paid (2)	million	53.70	57.10	56.10	54.60	50.20	46.10	46.60
Person-hours paid per tonne mined	number	0.23	0.22	0.22	0.22	0.19	0.21	0.19
Tonnes mined per person-hour paid	t	4.35	4.56	4.51	4.54	5.18	4.87	5.30
OTHER MINERAL OPERATIONS (3)								
Ore mined and rock quarried	Mt	170.50	173.00	167.90	178.40	167.50	152.10	151.60
Person-hours paid (2)	million	29.80	29.30	31.30	30.98	28.73	26.16	23.77
Person-hours paid per tonne mined	number	0.17	0.17	0.19	0.17	0.17	0.17	0.16
Tonnes mined per person-hour paid	t	5.72	5.90	5.36	5.76	5.83	5.81	6.38

Sources: Natural Resources Canada; Statistics Canada, catalogue nos. 26-201, 26-223 and 26-206.
(r) Revised.
(1) Excludes placer mining. (2) Person-hours paid for production and related workers only. (3) Includes asbestos, potash, gypsum, salt, miscellaneous nonmetals and coal.

TABLE 29. CANADA, AVERAGE WEEKLY WAGES (INCLUDING OVERTIME) FOR HOURLY RATED EMPLOYEES IN THE MINING, MINERAL MANUFACTURING, AND LOGGING AND FORESTRY INDUSTRIES, 1994-2002

	1994	1995	1996	1997	1998	1999	2000	2001	2002
					($)				
Oil and gas extraction	1 171.54	1 208.05	1 242.71	1 252.70	1 298.43	1 333.92	1 352.43	1 380.33	1 407.30
Mining	921.83	963.25	1 001.83	998.87	1 053.39	1 039.90	1 094.11	1 090.31	1 084.03
Coal mining	989.79	1 028.06	1 057.58	1 045.80	1 138.11	1 126.95	1 204.74	1 232.08	1 215.77
Metal ore mining	1 002.30	1 049.60	1 078.85	1 053.23	1 127.77	1 123.25	1 168.98	1 168.94	1 163.13
Nonmetallic mineral mining and quarrying	755.07	784.51	825.18	873.86	893.33	882.64	944.20	943.49	952.11
Support activities for mining and oil and gas extraction	816.27	817.21	895.53	948.30	978.06	970.21	1 013.57	1 049.05	1 074.27
Mineral manufacturing activities	705.67	712.75	733.82	752.42	770.92	782.43	796.89	808.12	830.14
Forestry, logging and support	700.01	697.64	745.69	786.46	766.33	773.42	810.15	830.84	849.77

Source: Statistics Canada; *Annual Estimates of Employment, Earnings and Hours*.

TABLE 30. CANADA, NUMBER OF STRIKES AND LOCKOUTS BY INDUSTRY, 2000-2002

	2000			2001			2002 (p)		
	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days
					(number)				
Agriculture	1	227	24 800	1	180	13 140	–	–	–
Logging and forestry	5	13 150	101 010	3	669	1 960	1	166	25 740
Fishing and trapping	–	–	–	–	–	–	–	–	–
Mining	9	3 625	160 210	13	3 898	109 630	3	501	61 660
Utilities	1	5	70	5	842	17 380	2	73	2 960
Construction	7	865	15 540	6	12 777	69 910	6	295	8 390
Manufacturing	129	21 450	403 720	119	17 215	514 220	92	21 504	541 975
Wholesale and retail trade	33	9 625	89 670	39	3 693	127 400	42	9 982	140 395
Transportation and utilities	35	4 737	79 510	35	8 258	364 190	22	4 300	84 710
Information and culture	10	3 761	69 810	11	2 966	42 950	18	6 717	482 500
Finance, insurance and real estate	24	2 498	59 900	17	5 097	44 950	12	1 878	73 530
Education, health and social sciences	65	41 820	307 460	74	109 724	585 720	32	63 772	370 293
Entertainment and hospitality	34	5 845	130 860	38	3 856	86 060	42	3 929	34 531
Public administration	24	35 962	219 060	19	51 021	218 940	20	53 640	1 202 700
Total, all industries	377	143 570	1 661 620	380	220 196	2 196 450	292	166 757	3 029 384

Source: Human Resources Development Canada, Workplace Information Directorate.
– Nil; (p) Preliminary.

TABLE 31. CANADA, NUMBER OF STRIKES AND LOCKOUTS BY MINING AND MINERAL MANUFACTURING INDUSTRY, 2000-2002

	2000			2001			2002 (p)		
	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days
					(number)				
MINING	9	3 625	160 210	13	3 898	109 630	3	501	61 660
Metals	3	1 710	140 200	7	3 067	99 520	–	–	–
Mineral fuels	3	1 629	15 830	2	100	2 500	–	–	–
Nonmetals	2	245	3 710	4	731	7 610	1	400	61 200
Quarries	1	41	470	–	–	–	2	101	460
MINERAL MANUFACTURING	21	2 384	70 410	11	1 384	45 800	15	1 877	139 690
Primary metals	3	1 010	32 630	6	1 196	42 310	9	1 612	122 990
Nonmetallic mineral products	17	874	34 780	5	188	3 490	6	265	16 700
Petroleum and coal products	1	500	3 000	–	–	–	–	–	–

Source: Human Resources Development Canada, Workplace Information Directorate.
– Nil; (p) Preliminary.

TABLE 32. SOURCE OF ORES HOISTED OR REMOVED FROM SELECTED TYPES OF MINES, 1998-2000

	1998			1999			2000		
	Underground	Open-Pit	Total	Underground	Open-Pit	Total	Underground	Open-Pit	Total
METALS									
Gold	16 579	19 875	36 454	15 810	28 989	44 799	15 558	26 245	41 802
Silver-lead-zinc	8 310	174	8 484	7 808	–	7 808	7 035	–	7 035
Iron ore	372	96 371	96 743	–	85 249	85 249	–	96 349	96 349
Nickel-copper-zinc	25 483	77 212	102 694	23 680	48 149	71 829	21 586	67 123	88 710
Miscellaneous metals	1 402	14 117	15 519	1 208	13 409	14 617	1 146	12 152	13 298
Total metals	52 145	207 748	259 893	48 506	175 796	224 302	45 324	201 869	247 194
NONMETALS									
Asbestos	x	x	x	x	x	x	x	x	x
Gypsum	977	7 885	8 863	1 037	8 627	9 665	912	8 036	8 949
Potash	39 514	–	39 514	29 346	–	29 346	33 560	0	33 560
Rock salt	13 277	–	13 277	11 816	–	11 816	11 102	0	11 102
Diamonds	–	402	402	–	3 166	3 166	0	3 190	3 190
Miscellaneous nonmetals	x	x	x	x	x	x	x	x	x
Total nonmetals	55 645	16 495	72 140	43 714	20 069	63 784	46 448	19 945	66 394
MINERAL FUELS									
Coal	3 910	91 453	95 363	2 333	85 939	88 272	1 526	83 675	85 201
Grand total	111 700	315 697	427 396	94 553	281 804	376 357	93 298	305 489	398 789
Percentage	26.14	73.87	100.00	25.12	74.88	100.00	23.40	76.60	100.00

Sources: Natural Resources Canada; Statistics Canada.
– Nil; x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 33. SOURCE OF MATERIAL HOISTED OR REMOVED FROM SELECTED TYPES OF MINES, 2000

	Underground Ore	Underground Waste	Open-Pit Ore	Open-Pit Waste	Open-Pit Overburden	Open-Pit Tailings
			(000 tonnes)			
METALS						
Gold	15 558	2 429	26 245	37 739	1 909	39 598
Silver-lead-zinc	7 035	282	–	689	–	5 676
Iron ore	–	–	96 349	1 122	–	57 318
Nickel-copper-zinc	21 586	1 172	67 123	46 877	274	86 471
Miscellaneous metals	1 146	56	12 152	18 770	–	11 943
Total metals	45 324	3 940	201 869	105 199	2 183	201 006
NONMETALS						
Asbestos	x	x	x	x	x	x
Gypsum	912	–	8 036	3 156	1 166	–
Potash	33 560	4 363	–	–	–	5 518
Rock salt	9 137	390	–	–	–	472
Diamonds	–	–	3 190	30 581	–	–
Miscellaneous nonmetals	x	x	x	x	x	x
Total nonmetals	44 484	4 754	19 945	49 718	4 336	10 185
MINERAL FUELS						
Coal	1 526	. .	83 675	. .	. .	. .
Total metals, nonmetals and mineral fuels	89 808	8 694	221 815	154 917	6 519	211 191

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 34. CANADA, ORE MINED AND ROCK QUARRIED IN THE MINING INDUSTRY, 1995-2000

Mines	1995	1996	1997	1998	1999	2000
				(000 tonnes)		
METALS						
Gold	25 120	30 901	33 924	36 454	44 799	41 802
Silver-lead-zinc	10 295	11 656	9 608	8 484	7 808	7 035
Iron ore	95 538	95 783	94 430	96 743	85 249	96 349
Nickel-copper-zinc	113 259	98 671	94 892	102 694	71 829	88 710
Miscellaneous metals	16 263	15 992	15 145	15 519	14 617	13 298
Total metals	260 475	253 003	247 999	259 893	224 302	247 194
NONMETALS						
Asbestos	x	x	x	x	x	x
Gypsum	8 623	8 584	9 141	8 863	9 665	8 949
Potash	40 196	34 103	38 932	39 514	29 346	33 560
Rock salt	9 854	11 226	12 690	13 277	11 816	11 102
Diamonds	–	–	–	402	3 166	3 190
Miscellaneous nonmetals	x	x	x	x	x	x
Total nonmetals	72 596	67 491	75 853	72 140	63 784	66 394
STRUCTURAL MATERIALS						
Stone of all kinds quarried	120 660	112 420	120 953	129 057	130 226	139 096
Sand and gravel	230 098	217 361	227 315	231 639	248 311	240 007
MINERAL FUELS						
Coal	97 707	100 359	101 735	95 363	88 272	85 201
Total ore mined and rock quarried	781 536	750 634	773 855	788 092	754 895	777 892

Sources: Natural Resources Canada; Statistics Canada.
– Nil; x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 35. CANADA, ORE MINED AND ROCK QUARRIED IN THE MINING INDUSTRY, 1961-2000

Year	Metals	Industrial Minerals (1)	Coal	Total
		(million tonnes)		
1961	90.1	96.7	. .	186.8
1962	103.6	103.8	. .	207.4
1963	112.7	120.4	. .	233.1
1964	128.0	134.1	. .	262.1
1965	151.0	146.5	. .	297.5
1966	147.6	171.8	. .	319.4
1967	169.1	177.5	. .	346.6
1968	186.9	172.7	. .	359.6
1969	172.0	178.8	. .	350.8
1970	213.0	179.1	. .	392.1
1971	211.5	185.8	. .	397.3
1972	206.0	189.7	. .	395.7
1973	274.9	162.6	. .	437.4
1974	278.7	178.8	. .	457.5
1975	264.2	158.7	. .	422.9
1976	296.5	167.1	. .	463.6
1977	299.5	205.2	33.8	538.5
1978	248.1	205.5	36.3	489.9
1979	274.8	200.1	39.8	514.6
1980	290.1	193.5	43.9	527.5
1981	301.5	172.5	48.2	522.2
1982	238.4	121.2	53.0	412.5
1983	219.0	137.0	54.8	410.8
1984	246.4	167.8	71.2	485.4
1985	245.0	171.9	76.7	493.6
1986	256.3	179.1	72.7	508.2
1987	266.2	197.5	77.5	541.1
1988	282.1	210.3	89.3	581.6
1989	283.8	209.4	87.7	580.9
1990	280.6	195.4	89.5	565.4
1991	271.4	166.4	90.3	528.0
1992	248.2	169.2	81.4	498.8
1993	236.5	167.9	87.6	458.4
1994	233.7	184.3	96.6	514.6
1995	260.5	193.3	97.7	551.4
1996	253.0	179.9	100.4	533.3
1997 (r)	248.0	196.8	101.7	546.5
1998	259.9	201.2	95.4	556.5
1999	224.3	194.0	88.2	506.5
2000	247.2	205.5	85.2	537.9

Sources: Natural Resources Canada; Statistics Canada.

. . Not available; (r) Revised.

(1) Includes nonmetallic mineral mining and all stone quarried, including stone used to make cement and lime. From 1979 onwards, coverage includes miscellaneous nonmetal mines previously excluded.

Note: Numbers may not add to totals due to rounding.

TABLE 36. CANADA, CRUDE MINERALS TRANSPORTED BY CANADIAN RAILWAYS, 1998-2002

	1998 (r)	1999	2000	2001	2002
			(000 tonnes)		
METALLIC MINERALS					
Iron ores and concentrates	38 765	32 263	38 964	28 978	30 283
Nickel and nickel-copper ores and concentrates	3 182	2 921	2 351	2 543	2 343
Zinc ores and concentrates	1 317	499	1 158	1 119	1 105
Copper ores and concentrates	1 189	1 179	1 484	1 683	1 289
Lead ores and concentrates	(a)	626	1 030	570	571
Metallic ores and concentrates, n.e.s.	698	96	99	169	313
Subtotal	45 151	37 584	45 086	35 062	35 904
NONMETALLIC MINERALS					
Potash (KCl)	13 890	13 378	14 197	12 819	13 096
Sulphur	6 897	7 570	7 446	6 373	7 064
Salt	1 852	1 319	1 218	1 414	1 357
Phosphate rock	1 097	94	468	773	1 023
Sand, gravel and stone	1 972	2 181	3 026	3 006	2 896
Other nonmetallic minerals	5 035	5 870	5 575	5 466	5 712
Subtotal	30 742	30 412	31 930	29 851	31 148
MINERAL FUELS					
Coal	37 805	42 039	39 253	40 119	35 148
Subtotal	37 805	42 039	39 253	40 119	35 148
Total crude minerals	113 699	110 034	116 269	105 032	102 200
Total revenue freight (1) moved by Canadian railways	279 511	236 674	252 116	240 633	242 556
Crude minerals as a percentage of total revenue freight	40.7	46.5	46.1	43.6	42.1

Source: Statistics Canada, catalogue no. 52-001-XIE.
n.e.s. Not elsewhere specified; (r) Revised.
(a) Data are included with metallic ores and concentrates, n.e.s.
(1) Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.
Note: In previous years this table was calculated using Statistics Canada's annual data series. As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1998 have been recently recalculated using the monthly data series.

TABLE 37. CANADA, PROCESSED MINERAL PRODUCTS TRANSPORTED BY CANADIAN RAILWAYS, 1998-2002

	1998 (r)	1999	2000	2001	2002
			(000 tonnes)		
METALLIC MINERAL PRODUCTS					
Alumina	4 553	5 174	5 107	5 520	5 915
Iron and steel, primary or semi-finished	4 418	2 763	3 650	3 826	4 426
Copper, primary or semi-finished	417	1 137	611	607	566
Aluminum, primary or semi-finished	1 451	1 526	1 460	1 977	2 116
Other nonferrous metals, primary or semi-finished	1 020	413	454	429	583
Articles of metal-based products	–	1 121	944	732	712
Metallic waste and scrap	1 563	2 049	2 022	1 968	2 103
Total metallic mineral products	13 422	14 186	14 248	15 059	16 421
NONMETALLIC MINERAL PRODUCTS					
Sulphuric acid	2 561	2 245	2 384	2 352	2 516
Fertilizers (excluding potash)	5 038	4 963	5 041	4 507	4 936
Cement	2 084	2 261	2 443	2 442	2 412
Other nonmetallic mineral products	2 023	1 040	828	1 149	1 501
Total nonmetallic mineral products	11 706	10 509	10 696	10 450	11 365
MINERAL FUEL PRODUCTS					
Gasoline and aviation turbine fuel	1 604	1 494	1 539	1 537	2 028
Fuel oils and crude petroleum	1 505	3 297	3 357	3 953	4 350
Gaseous hydrocarbons, including liquefied petroleum gases	3 814	4 258	4 451	4 421	4 944
Coal coke and petroleum coke	1 361	1 253	1 344	1 315	1 726
Other refined petroleum and coal products	3 606	1 881	1 994	2 090	2 318
Total mineral fuel products	11 890	12 183	12 685	13 316	15 366
Total processed mineral products	37 198	36 878	37 629	38 825	43 152
Total revenue freight (1) moved by Canadian railways	279 511	236 674	252 116	240 633	242 556
Processed mineral products as a percentage of total revenue freight	13.3	15.6	14.9	16.1	18.0

Source: Statistics Canada, catalogue no. 52-001-XIE.
– Nil; (r) Revised.
(1) Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.
Note: In previous years this table was calculated using Statistics Canada's annual data series. As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1998 have been recently recalculated using the monthly data series.

TABLE 38. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS TRANSPORTED BY CANADIAN RAILWAYS, 1961-2002

Year	Total Revenue Freight (1)	Total Crude Minerals	Total Processed Mineral Products	Total Crude and Processed Minerals	Crude Minerals and Processed Mineral Products as a Percentage of Revenue Freight
	(million tonnes)				(%)
1961	138.9	54.1	13.6	67.7	48.7
1962	146.0	60.3	13.8	74.1	50.8
1963	154.6	62.9	15.5	78.4	50.7
1964	180.0	74.6	15.9	90.5	50.3
1965	186.2	80.9	17.3	98.2	52.7
1966	194.5	80.6	17.8	94.4	50.6
1967	190.0	81.2	17.7	98.9	52.1
1968	195.4	86.7	18.8	105.5	54.0
1969	189.0	81.9	27.6	109.5	57.9
1970	211.6	97.5	28.4	125.9	59.5
1971	214.5	95.6	27.4	123.0	57.3
1972	215.8	89.4	27.6	117.0	54.2
1973	241.2	113.1	29.1	142.2	59.0
1974	246.3	115.3	30.9	146.2	59.4
1975	226.0	110.6	26.6	137.2	60.7
1976	238.5	116.6	25.5	142.1	59.6
1977	247.2	121.1	25.7	146.8	59.4
1978	238.8	107.7	26.2	133.9	56.1
1979	257.9	127.2	26.6	153.8	59.6
1980	254.4	124.8	24.6	149.4	58.7
1981	246.6	120.7	26.4	147.1	59.7
1982	212.5	95.7	21.0	116.7	54.9
1983	222.8	95.3	22.7	118.0	53.0
1984	254.6	121.1	25.1	146.2	57.4
1985	250.6	125.2	24.3	149.5	59.7
1986	249.8	121.2	23.0	144.2	57.7
1987	261.4	122.2	22.7	144.9	55.4
1988	269.4	134.9	23.2	158.1	58.7
1989	247.0	122.3	23.1	145.4	58.9
1990	226.3	112.1	20.1	132.2	58.4
1991	233.3	114.4	19.1	133.5	57.2
1992	226.2	102.8	20.9	123.7	54.7
1993	224.0	100.8	21.4	122.2	54.6
1994	253.6	112.6	21.4	134.0	52.9
1995	253.7	118.4	22.0	140.4	55.4
1996	252.1	118.1	21.6	139.7	55.4
1997 (r)	288.9	118.2	31.5	149.7	51.8
1998 (r)	279.5	113.7	37.2	150.9	54.0
1999	236.7	110.0	36.9	146.9	62.1
2000	252.1	116.3	37.6	153.9	61.0
2001	240.6	105.0	38.8	143.8	59.8
2002	242.6	102.2	43.2	145.4	59.9

Source: Statistics Canada, catalogue no. 52-001-XIE.

(r) Revised.

(1) Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.

Note: In previous years, this table was calculated using Statistics Canada's annual data series. As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1997 and 1998 have been recalculated using the monthly data series.

TABLE 39. CANADA, CRUDE MINERALS LOADED AND UNLOADED IN COASTWISE SHIPPING, 2001

	Loaded							Unloaded						
	Arctic	Atlantic	St. Lawrence	Great Lakes	Mackenzie	Pacific	Total	Arctic	Atlantic	St. Lawrence	Great Lakes	Mackenzie	Pacific	Total
							(tonnes)							
METALLIC MINERALS														
Iron ore and concentrates	–	–	6 235 907	–	–	–	6 235 907	–	–	775 727	5 495 201	–	–	6 270 928
Aluminum ores and concentrates	–	–		–	–	–	–	–	–	–	–	–	–	
Other ores and concentrates	42 282	–	2 756 140	–	–	–	2 798 422	–	–	2 781 998	16 424	–	–	2 798 422
Total metallic minerals	42 282	–	8 992 047	–	–	–	9 034 329	–	–	3 557 725	5 511 625	–	–	9 069 350
NONMETALLIC MINERALS														
Salt	–	1 542 618	6822	1 620 342	–	50 520	3 220 302	–	383 912	1 538 970	1 225 746	–	50 520	3 199 148
Limestone	–	482 989	0	1 828 135	–	1 191 624	3 502 748	–	174 262	308 727	1 828 135	–	1 191 624	3 502 748
Stone, sand and gravel	–	179 639	8000	1 672 340	–	1 702 394	3 562 373	–	187 639	56 006	1 616 334	–	1 702 394	3 562 373
Potash	–	–	–	20 759	–	–	20 759				20 759	–	–	–
Sulphur	–	–	–	–	–	–	–							
Other mineral products (including clays, gypsum and dolomite)	–	–	581	642 116	–	53259	695 956	–	–	613 098	557 244	–	53259	1 223 599
Total nonmetallic minerals	–	2 205 246	15 403	5 783 692	–	2 997 797	11 002 138	–	745 813	2 516 799	5 248 218	–	2 997 797	11 508 627
MINERAL FUELS														
Coal and coke	–	–	–	1 064 797	–	122 496	1 187 293	–	–	–	1 064 797	–	122 496	1 187 293
Crude petroleum	–	5 549 270	–	–	–	–	5 549 270	–	4 921 325	627 945	–	–	–	5 549 270
Total mineral fuels	–	5 549 270	–	1 064 797	–	122 496	6 736 563	–	4 921 325	627 945	1 064 797	–	122 496	6 736 563
Total crude minerals	42 282	7 754 516	9 007 450	6 848 489	–	3 120 293	26 773 030	–	5 667 138	6 702 469	11 824 640	–	3 120 293	27 314 540
Total all commodities (1)	96 001	12 384 536	12 339 793	14 331 377	7 500	14 134 024	53 293 232	161 394	9 873 834	13 282 792	15 792 478	12 215	14 131 338	53 257 052
Crude minerals as a percentage of all products	44.0	62.6	73.0	47.8	–	22.1	50.2	–	57.4	50.5	74.9	–	22.1	51.3

Source: Statistics Canada.
– Nil.
(1) Includes metallic minerals, nonmetallic minerals and mineral fuels, along with all other cargo loaded and unloaded in coastwise shipping.
Note: Numbers may not add to totals due to rounding.

TABLE 40. CANADA, PROCESSED MINERAL PRODUCTS LOADED AND UNLOADED IN COASTWISE SHIPPING, 2001

	Loaded							Unloaded						
	Arctic	Atlantic	St-Lawrence	Great Lakes	Mackenzie	Pacific	Total	Arctic	Atlantic	St. Lawrence	Great Lakes	Mackenzie	Pacific	Total
							(tonnes)							
METALLIC MINERAL PRODUCTS														
Iron, steel and alloys	–	–		4 634		30 006	34 640	–	–	–	7 757	–	30 006	37 763
Other nonferrous metal products	–	–					–	–	–	–	–	–	–	–
Other base-metal products	–	–	306 806	3 821			310 627	–	–	298 498	9 721	–	–	308 219
Metallic waste and scrap	–	–	78 161	294 822			372 983	–	–	40 088	333 061	–	–	373 149
Total metallic mineral products	–	–	384 967	303 277	–	30 006	718 250	–	–	338 586	350 539	–	30 006	719 131
NONMETALLIC MINERALS PRODUCTS														
Cement and related products	–	4 611	–	413 142	–	32 451	450 204	–	4 611	–	416 272	–	32 451	453 334
Other fabricated nonmetallic minerals, n.e.s.	–	213 913	–	–	–	–	213 913	–	24	–		–	–	24
Nonmetallic waste and scrap	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total nonmetallic mineral products	–	218 524	–	413 142	–	32 451	664 117	–	4 635	–	416 272	–	32 451	453 358
MINERAL FUEL PRODUCTS														
Gasoline and aviation turbine fuel	15 155	202 624	766 552	–	1 595	144 336	1 130 262	34 212	211 331	398 389	–	4 295	144 336	792 563
Petroleum coke	85	–	40 165	–	–	–	40 250	69	1 250	90 333	–	16	–	91 668
Other fabricated mineral fuels, n.e.s.	21 704	1 755 211	1 212 425	1 788 080	5 905	77 940	4 861 265	78 891	1 576 065	1 517 984	1 624 135	7 210	77 940	4 882 225
Total mineral fuel products	36 944	1 957 835	2 019 142	1 788 080	7 500	222 276	6 031 777	113 172	1 788 646	2 006 706	1 624 135	11 521	222 276	5 766 456
Total fabricated mineral products	36 944	2 176 359	2 404 109	2 504 499	7 500	284 733	7 414 144	113 172	1 793 281	2 345 292	2 390 946	11 521	284 733	6 938 945
Total all commodities (1)	96 001	12 384 536	12 339 793	14 331 377	7 500	14 134 024	53 293 232	161 394	9 873 834	13 282 792	15 792 478	12 215	14 131 338	53 257 052
Fabricated minerals as a percentage of all commodities	38.5	17.6	19.5	17.5	100.0	2.0	13.9	70.1	18.2	17.7	15.1	94.3	2.0	13.0

Source: Statistics Canada.
– Nil; n.e.s. Not elsewhere specified.
(1) Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded in coastwise shipping.
Note: Numbers may not add to totals due to rounding.

TABLE 41. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS LOADED AT CANADIAN PORTS IN COASTWISE SHIPPING, 1961-2001

Year	Total All Commodities (1)	Total Crude Minerals	Total Processed Minerals	Crude Minerals and Processed Mineral Products as a Percentage of All Products
		(000 tonnes)		(%)
1961	41 861	9 527	8 857	43.9
1962	39 763	8 361	9 768	45.6
1963	40 328	7 998	9 942	44.5
1964	47 171	8 522	11 194	41.8
1965	48 200	9 183	11 766	43.5
1966	55 122	10 155	12 653	41.4
1967	49 799	11 509	12 207	47.6
1968	50 921	13 698	13 245	52.9
1969	51 890	12 746	14 181	51.9
1970	57 301	14 415	14 818	51.0
1971	55 128	14 783	15 374	54.7
1972	55 326	14 197	15 290	53.3
1973	55 314	16 573	15 615	58.2
1974	53 633	11 723	16 575	52.8
1975	54 373	15 687	17 510	61.1
1976	53 882	15 924	16 208	59.6
1977	58 309	18 131	17 435	61.0
1978	60 668	18 318	16 619	57.6
1979	79 950	22 130	17 486	49.6
1980	82 761	22 947	17 134	48.4
1981	71 271	17 849	16 669	48.4
1982	65 881	16 473	13 214	45.1
1983	67 598	21 248	12 025	49.2
1984	68 698	22 798	11 909	50.5
1985	61 717	19 867	10 291	48.9
1986	60 506	19 901	10 264	49.9
1987	67 572	20 969	11 118	47.5
1988	69 974	23 325	11 676	50.0
1989	62 016	22 963	11 825	56.1
1990	60 360	22 430	16 096	63.8
1991	58 430	19 624	10 370	51.3
1992	52 262	22 125	9 325	60.2
1993	49 976	21 088	8 168	58.5
1994	51 534	21 221	9 510	59.6
1995	50 370	20 626	8 825	58.5
1996	48 829	22 393	7 634	61.5
1997	46 639	20 298	7 461	59.5
1998	47 928	23 358	8 142	65.7
1999	50 791	25 076	7 556	64.2
2000	55 496	26 821	9 234	65.0
2001	53 293	26 773	7 414	64.1

Source: Statistics Canada.

(1) Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded in coastwise shipping.

TABLE 42. CANADA, CRUDE MINERALS LOADED AND UNLOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE, 1999-2001

	1999		2000		2001	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
			(tonnes)			
METALLIC MINERALS						
Iron ore and concentrates	28 031 061	7 526 759	29 871 259	7 414 681	22 658 213	5 650 994
Aluminum ores and concentrates	15 586	2 841 851	–	2 825 699	2 775	2 698 940
Lead and zinc ores and concentrates	. .	. .	. .	. .	. .	. .
Copper and nickel ores and concentrates	474 800	458 345	754 735	641 056	713 230	683 173
Other metallic ores and concentrates (1)	2 340 790	922 602	1 059 218	616 231	1 371 274	537 030
Metallic waste and scrap	. .	. .	2 132 949	132 743	2 185 772	160 561
Total metallic minerals	30 862 237	11 749 557	33 818 161	11 630 410	26 931 264	9 730 698
NONMETALLIC MINERALS						
Limestone	2 807 913	2 932 627	2 619 650	2 769 477	1 583 142	2 420 994
Stone, sand and gravel	1 181 787	369 750	7 054 625	777 262	8 252 197	747 784
Salt	3 717 679	1 096 312	3 488 111	852 116	4 368 544	1 567 922
Sulphur	5 379 066	309	5 518 670	8 607	5 286 602	6 711
Potash	4 834 806	6 656	5 118 366	–	4 326 186	92
Other nonmetallic mineral products	12 986 306	3 273 108	7 928 137	1 612 986	7 268 700	1 396 951
Total nonmetallic minerals	30 907 557	7 678 762	31 727 559	6 020 448	31 085 371	6 140 454
MINERAL FUELS						
Coal and coke	32 312 668	20 561 540	30 757 341	22 728 941	28 508 272	25 083 445
Crude petroleum	9 281 348	28 450 563	12 406 490	29 198 583	11 193 726	32 173 380
Total mineral fuels	41 594 016	49 012 103	43 163 831	51 927 524	39 701 998	57 256 825
Total crude minerals	103 363 810	68 440 422	108 709 551	69 578 382	97 718 633	73 127 977
Total all commodities (1)	179 172 916	101 485 641	187 704 005	105 933 346	174 723 618	112 135 343
Crude minerals as a percentage of all commodities	57.7	67.4	57.9	65.7	56.0	65.0

Source: Statistics Canada.
– Nil; . . Not available.
(1) includes lead, zinc and other metallic ores and concentrates not specified.
Note: Numbers may not add to totals due to rounding.

TABLE 43. CANADA, PROCESSED MINERAL PRODUCTS LOADED AND UNLOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE,(1) 1999-2001

	1999		2000		2001	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
			(tonnes)			
METALLIC MINERAL						
Iron, steel and alloys	145 844	1 079 083	519 265	4 026 614	578 232	2 135 667
Nonferrous metals, n.e.s.	885 477	4 112 018	1 099 106	5 844 308	1 117 190	5 600 392
Total metallic mineral products	1 031 321	5 191 101	1 618 371	9 870 922	1 695 422	7 736 059
NONMETALLIC MINERAL PRODUCTS						
Cement and related products	3 525 229	713 202	3 094 127	633 424	3 349 490	409 169
Other nonmetallic minerals, n.e.s.	1 273 210	743 659	1 127 099	876 850	517 662	788 646
Total nonmetallic mineral products	4 798 439	1 456 861	4 221 226	1 510 274	3 867 152	1 197 815
MINERAL FUEL PRODUCTS						
Gasoline	4 326 864	1 851 140	4 707 087	2 262 669	275 796	1 059 782
Fuel oil	3 775 318	2 282 998	5 848 103	2 903 795	7 355 125	4 483 354
Coke, petroleum and coal products	441 624	1 346 534	685 078	1 742 630	655 769	2 046 628
Other mineral fuels, n.e.s.	2 895 947	1 613 047	723 043	905 100	870 806	1 563 256
Total mineral fuel products	11 439 753	7 093 719	11 963 311	7 814 194	9 157 496	9 153 020
Total processed mineral products	17 269 513	13 741 681	17 802 908	19 195 390	14 720 070	18 086 894
Total all commodities (1)	179 172 916	101 485 641	187 704 005	105 933 346	174 723 618	112 135 343
Processed mineral products as a percentage of all commodities	9.6	13.5	9.5	18.1	8.4	16.1

Source: Statistics Canada.
n.e.s. Not elsewhere specified.
(1) Includes metallic mineral products, nonmetallic mineral products, and mineral fuel products, along with all other cargo loaded and unloaded at Canadian ports.
Note: Numbers may not add to totals due to rounding.

TABLE 44. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS LOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE, 1961-2001

Year	Total All Commodities (1)	Total Crude Minerals	Total Processed Minerals	Crude Minerals and Processed Mineral Products as a Percentage of All Products
		(000 tonnes)		(%)
1961	48 771	23 241	2 133	52.0
1962	54 676	30 446	2 296	59.9
1963	62 031	32 214	2 503	56.0
1964	75 760	42 087	2 602	59.0
1965	74 521	41 338	2 746	59.2
1966	76 192	41 374	3 350	58.7
1967	72 598	42 704	3 701	63.9
1968	78 663	48 680	2 960	65.6
1969	70 432	42 442	3 456	65.2
1970	95 807	55 849	4 965	63.5
1971	95 887	53 245	5 022	60.8
1972	98 988	51 912	9 091	61.6
1973	112 434	64 195	10 103	66.1
1974	106 110	64 093	9 041	68.9
1975	102 444	61 970	7 495	67.8
1976	114 815	71 527	6 108	67.6
1977	119 770	70 257	5 979	63.7
1978	116 522	62 291	7 556	59.9
1979	134 639	79 685	8 901	65.8
1980	138 161	67 898	11 770	57.7
1981	145 445	83 007	9 022	63.3
1982	125 282	65 594	7 115	58.0
1983	129 490	67 152	6 197	56.6
1984	145 322	82 752	7 986	62.4
1985	143 421	83 878	10 814	66.0
1986	144 561	84 720	8 303	64.3
1987	158 994	86 085	10 488	60.7
1988	171 064	98 934	12 227	65.0
1989	159 069	90 807	13 624	65.7
1990	159 039	88 504	15 107	65.1
1991	168 030	90 165	16 138	63.3
1992	153 786	78 600	14 643	60.6
1993	152 162	81 418	16 723	64.5
1994	169 463	94 423	15 725	65.0
1995	176 540	100 103	16 346	66.0
1996	174 306	96 952	18 580	66.3
1997	187 717	110 983	18 467	69.0
1998	178 893	107 719	16 419	69.4
1999	179 173	103 364	17 269	67.3
2000	187 704	108 709	17 803	67.4
2001	174 724	97 719	14 720	64.4

Source: Statistics Canada.

(1) Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded at Canadian ports.

TABLE 45. CANADA, CAPITAL AND REPAIR EXPENDITURES BY SELECTED INDUSTRIAL SECTOR, 2001-03

		Capital Expenditures			Repair Expenditures		
	Year	Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
				($ millions)			
Agriculture, forestry, fishing and hunting	2001	1 677.6	3 842.0	5 519.6	804.0	2 763.2	3 567.2
	2002 (p)	1 670.3	3 812.0	5 482.3	..	..	..
	2003 (i)	1 737.4	3 805.1	5 542.5	..	..	..
Mining (1)	2001	24 427.7	5 462.6	29 890.2	795.6	2 274.4	3 069.9
	2002 (p)	20 190.9	6 223.5	26 414.5	..	..	..
	2003 (i)	19 342.4	4 901.9	24 244.3	..	..	..
Manufacturing	2001	3 521.6	15 593.5	19 115.1	1 211.2	9 375.0	10 586.2
	2002 (p)	2 370.9	14 475.7	16 849.6	..	..	..
	2003 (i)	2 451.9	15 510.4	17 962.3	..	..	..
Construction	2001	355.5	2 672.7	3 028.2	68.9	1 135.5	1 204.3
	2002 (p)	395.5	2 971.3	3 365.8	..	..	..
	2003 (i)	418.8	3 123.2	3 542.0	..	..	..
Transportation and warehousing	2001	4 294.1	6 416.3	10 710.4	1 494.8	4 093.4	5 588.2
	2002 (p)	4 051.5	7 543.9	11 595.4	..	..	..
	2003 (i)	4 009.0	7 813.1	11 822.2	..	..	..
Utilities	2001	6 144.9	3 514.3	9 659.2	941.1	1 148.4	2 089.5
	2002 (p)	7 255.3	4 200.9	11 456.2	..	..	..
	2003 (i)	7 852.5	3 533.3	11 385.8	..	..	..
Wholesale and retail trade	2001	2 787.8	6 583.9	9 371.7	538.9	955.3	1 494.3
	2002 (p)	2 777.9	6 503.0	9 280.9	..	..	..
	2003 (i)	3 117.4	6 778.1	9 895.5	..	..	..
Housing	2001	43 609.6	–	43 609.6	6 036.4		6 036.4
	2002 (p)	52 733.1	–	52 733.1	..	..	..
	2003 (i)	55 381.2	–	55 381.2	..	..	..
Total (2)	2001	86 818.8	44 085.3	130 904.0	11 890.9	21 745.2	33 636.0
	2002 (p)	91 445.4	45 730.3	137 177.8	..	..	..
	2003 (i)	94 310.6	46 465.1	139 775.8	..	..	..
Mining as a percentage of total	2001	28.1	12.4	22.8	6.7	10.5	9.1
	2002 (p)	22.1	13.6	19.3	..	..	..
	2003 (i)	20.5	10.5	17.3	..	..	..

Source: Statistics Canada.

– Nil; . . Not available; (i) Intentions; (p) Preliminary actual.

(1) Includes mines, quarries and oil wells. (2) Includes finance, real estate, insurance, commercial services, institutions and government departments.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the North American Industry Classification System.

TABLE 46. CANADA, CAPITAL AND REPAIR EXPENDITURES IN THE MINERAL INDUSTRY(1) BY PROVINCE AND TERRITORY, 2001-03

Province/ Territory	Year	Capital Expenditures			Repair Expenditures		
		Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
				($ millions)			
Newfoundland and Labrador	2001	x	x	1 117.4	x	x	x
	2002 (p)	x	x	928.7	..	..	..
	2003 (i)	x	x	1 214.1	..	..	..
Prince Edward Island	2001	x	x	x	x	x	x
	2002 (p)	x	x	2.5	..	..	..
	2003 (i)	x	2.3	2.3	..	..	..
Nova Scotia	2001	781.0	77.4	858.3	2.3	32.2	34.4
	2002 (p)	x	x	1 127.9	..	..	..
	2003 (i)	961.6	24.9	986.4	..	..	..
New Brunswick	2001	x	x	138.3	x	x	66.1
	2002 (p)	82.2	22.4	104.6	..	..	..
	2003 (i)	78.1	19.9	97.9	..	..	..
Quebec	2001	653.1	166.1	819.3	55.0	325.3	380.3
	2002 (p)	413.5	127.3	540.7	..	..	..
	2003 (i)	338.7	162.4	501.1	..	..	..
Ontario	2001	503.5	230.2	733.7	58.7	320.9	379.6
	2002 (p)	462.6	236.0	698.7	..	..	..
	2003 (i)	450.0	252.8	702.8	..	..	..
Manitoba	2001	225.2	24.1	249.3	2.8	59.9	62.8
	2002 (p)	167.0	41.9	208.9	..	..	..
	2003 (i)	153.3	28.5	181.9	..	..	..
Saskatchewan	2001	1 701.1	133.9	1 834.9	81.6	143.2	224.8
	2002 (p)	1 334.9	139.3	1 474.2	..	..	..
	2003 (i)	1 349.2	119.8	1 469.0	..	..	..
Alberta	2001	15 533.3	4 478.7	20 012.0	452.3	939.6	1 391.9
	2002 (p)	13 506.2	4 877.5	18 383.6	..	..	..
	2003 (i)	12 529.6	3 945.5	16 475.0	..	..	..
British Columbia	2001	2 742.0	175.9	2 917.9	102.0	261.4	363.4
	2002 (p)	1 748.2	119.5	1 867.6	..	..	..
	2003 (i)	1 894.3	114.3	2 008.6	..	..	..
Yukon	2001	x	x	19.1	x	x	x
	2002 (p)	x	x	9.2	..	..	..
	2003 (i)	13.8	0.6	14.4	..	..	..
Northwest Territories	2001	1 029.6	69.0	1 098.6	19.0	74.0	93.0
	2002 (p)	885.2	116.0	1 002.1	..	..	..
	2003 (i)	493.3	31.0	524.3	..	..	..
Nunavut	2001	x	x	x	x	x	x
	2002 (p)	65.1	0.7	65.8			
	2003 (i)	x	x	66.4			
Total Canada	2001	24 427.7	5 462.6	29 890.2	795.6	2 274.4	3 069.9
	2002 (p)	20 190.9	6 223.5	26 414.5	..	..	..
	2003 (i)	19 342.4	4 901.9	24 244.3	..	..	..

Source: Statistics Canada.
. . Not available; (i) Intentions; (p) Preliminary actual; x Confidential.
(1) Includes mines, quarries and oil wells.
Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the North American Industry Classification System.

TABLE 47. CANADA, CAPITAL AND REPAIR EXPENDITURES IN THE MINING AND OIL AND GAS EXTRACTION INDUSTRIES, 2001-03

	2001			2002 (p)	2003 (i)
	Capital	Repair	Total	Capital	Capital
			($ millions)		
MINING					
Metal ore mining					
Iron	x	x	x	x	x
Gold and silver	418.1	285.5	703.6	491.2	389.90
Lead-zinc	x	x	x	x	x
Nickel-copper	231.6	176.7	408.3	271.9	493.00
Copper-zinc	263.6	173.3	436.9	242.1	170.20
Uranium	x	x	x	x	52.50
Other metal mines	256.7	x	256.7	60.9	57.20
Total	1 626.8	925.7	2552.5	1 280.0	1 299.50
Nonmetallic mineral mining and quarrying					
Stone	66.9	52.8	119.7	59.2	59.60
Sand and gravel, clay, and ceramic and refractory materials	78.3	62.5	140.8	63.2	69.60
Asbestos	x	x	x	x	x
Gypsum	15.1	17.2	32.3	28.6	37.00
Potash	119.9	95.7	215.6	117.7	111.00
Peat	x	x	x	x	x
Other nonmetal mines	733.2	143.0	876.2	593.9	168.80
Total	1 092.5	412.3	1504.8	922.6	488.60
Coal	154.2	176.3	330.5	193.4	182.10
Oil and gas extraction	25 630.6	1 170.8	26801.4	22 739.8	21 222.50
Support activities for mining and oil and gas extraction	1386.1	384.9	1771.0	1278.6	1 051.50
Total mineral industry	29 890.2	3 069.9	32960.1	26 414.5	24 244.30

Source: Statistics Canada.

(i) Intentions; (p) Preliminary actual; x Confidential.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the North American Industry Classification System.

Definitions and Valuation: Mineral Production, Shipments and Trade

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MINERAL STATISTICS

The publication of statistics on the mineral production of Canada was instituted by the Geological and Natural History Survey of Canada as early as 1886. The Department of Mines carried out this compilation through the early part of the twentieth century. Subsequently, the work was transferred to Statistics Canada, which published the data for the period 1921 to 1978. In January 1979, the responsibility for Canadian non-fuel mineral statistics was transferred from Statistics Canada to the Department of Energy, Mines and Resources (now Natural Resources Canada). Statistics Canada retains responsibility for fuels and mineral manufacturing statistics (including cement, lime, clay, and smelting and refining).

The construction of new metallurgical plants and the development of new types of ore have resulted in changes in methods of compilation over the period but, in general, the following principles have been followed.

For nonmetallic minerals such as asbestos, talc, barite, etc., and for structural materials such as stone, cement, etc., the mine or quarry shipments are taken to represent production. Usually there is little difference between actual output and mine shipments, and it is more convenient and practical to measure the product at the latter point. Values are computed on the f.o.b. shipping point basis and they represent, therefore, the amounts actually received by the producers. Values are adjusted to exclude the costs of containers, taxes, duties, sales discounts and outward-bound transportation.

Production data for certain simple metallic ores such as iron ore, uranium, etc., are compiled in a similar manner, that is, products shipped from a specific shipping point at f.o.b. values. For some metals this is not practical and an attempt is made to measure output in terms of recoverable metals in concentrates shipped, which are then valued at current market prices.

The value of metallic mineral production calculated in this manner does not coincide with the amounts actually received by the producers.

DETAILS OF THE METHODS USED IN COMPUTING THE MINERAL PRODUCTION OF CANADA

Metallic Mineral Production

Antimony

Production includes recoverable antimony in concentrates shipped. The value is calculated using the yearly average New York dealer price.

Bismuth

Production includes recoverable bismuth in concentrates shipped. The value is calculated using the yearly average New York dealer price.

Cadmium

Cadmium is associated with zinc. Production includes the recoverable content of cadmium in the zinc-lead concentrates shipped, valued at the yearly average New York dealer price.

Calcium

Output figures represent calcium metal plus the calcium content of alloys from Canadian sources valued at the average yearly price of metal crowns.

Cesium

Production figures represent the cesium oxide content of pollucite ore shipped. The value is as reported by the producer.

Cobalt

Production includes recoverable cobalt in concentrates shipped. The value is calculated using the average yearly cathode dealer spot prices.

Copper

Production includes recoverable copper in concentrates shipped. The value is calculated using a combination of the

Commodities Exchange, Inc. (COMEX) first position price and the average London Metal Exchange Grade A Settlement price.

Germanium

Production includes germanium contained in concentrates shipped with values as reported by the shipper.

Gold

Production includes gold in crude bullion obtained directly from placer workings and lode gold mines, and recoverable gold in all types of ores and concentrates shipped. The value is calculated using the average final price as established by bullion dealers in London.

Ilmenite

Production includes shipments of direct shipping grade ore at Canada's sole shipper's reported value.

Indium

Production includes quantities recovered in the smelting of silver-lead-zinc ores from Canadian sources. The output is valued by the shipper.

Iron Ore

Production figures represent product shipments (pellets, concentrates, ores) at the values shown by the shippers. Production from steel plant waste oxides is excluded.

Iron (Remelt)

This is sometimes called pig iron or Sorel iron. It is a co-product in the smelting of ilmenite ores. Quantity and value figures are those reported by the producer.

Lead

Production includes recoverable lead in concentrates shipped. The value is computed at the average producer price for the year.

Lithium

Production figures represent the lithium oxide content of spodumene and amblygonite ore shipped. The value is as reported by the producer.

Magnesium

Output figures represent magnesium metal, plus the magnesium content of alloys from Canadian sources. Values are compiled using the average yearly price of primary ingots.

Molybdenum

Production figures are the molybdenum content of the oxides, ferromolybdenum and sulphides shipped; the value is that shown by the shipper.

Nickel

Production includes recoverable nickel in concentrates shipped. The value is calculated using an assessment price based on London Metal Exchange prices.

Niobium (Columbium)

Production includes niobium (columbium) contained in concentrates shipped with values as reported by the shipper.

Platinum Group Metals (PGM)

Production figures for iridium, palladium, platinum, ruthenium and rhodium include recoverable metal in concentrates shipped. Quantities are valued using average New York dealer prices or London Metal Exchange prices, depending on the metal.

Rhenium

Production figures reflect the content of concentrates shipped. Values are those reported by the shipper.

Rubidium

Production figures include the content of concentrates shipped. Values are as reported by the shipper.

Selenium

Production includes selenium produced as a refinery by-product from Canadian sources and recoverable selenium contained in concentrates exported. The quantities are valued at the average New York dealer price for the year.

Silver

Production includes silver in crude bullion obtained directly from placer workings and lode gold mines, and recoverable silver in all types of ores and concentrates shipped. The value is calculated using the average of Toronto quotations for the year.

Tantalum

Production comprises the tantalum pentoxide content of concentrates shipped as valued by the shipper.

Tellurium

Production includes tellurium produced as a refinery by-product from Canadian sources and recoverable tellurium contained in concentrates exported. The quantities are valued at the average producers' price for the year.

Uranium

Producers of uranium precipitates or concentrates report the metal content (U) of the shipments and the value is calculated by Natural Resources Canada.

Zinc

Production comprises recoverable zinc in concentrates shipped. The value is calculated using the average London Metal Exchange price for the year.

Nonmetallic Mineral Production

Owing to the fact that it is difficult to obtain figures of the actual production of nonmetallic minerals in Canada, and since the first actual measurement is when the product is sold, plant shipments have been taken to represent production in all cases.

Barite

Production is the shipments of the various grades at the selling value, f.o.b. shipping points.

Cement

Production comprises shipments of Portland and masonry cements and transfers to other corporate divisions for use in other manufacturing processes. Values are f.o.b. plant, as reported by the shipper.

Chrysotile (Asbestos)

Production figures represent shipments of the various grades at the total selling value, f.o.b. shipping points, less the value of containers.

Clay Products

Production represents shipments of brick and other clay products made from domestic clays, and shipments of unmanufactured clays (bentonite, diatomite) at the total selling value, f.o.b. works, as reported by the operators. Data relating to clay products manufactured from imported clays are not included.

Diamonds

Production is shipments from the mine. The value is calculated by Natural Resources Canada.

Gemstones

Production is the tonnage of crude and rough cut amethyst, jade and labradorite shipped at its selling value, f.o.b. shipping points.

Graphite

Production is the shipments of various grades from the mill at its selling value, f.o.b. the mill, less container costs.

Gypsum[1]

Production is taken as the tonnage of crude gypsum and anhydrite shipped from quarries or mines in lump, crushed or fine-ground forms. The value is that reported by the operators. (Note: Gypsum used in the manufacture of cement in Canadian cement plants is excluded.)

Lime

Production represents the tonnage of hydrated and quicklime shipped (sold by the producer) together with the tonnage of these limes produced and used by the producers of chemicals and allied products. The values are as reported by the producer.

Magnesitic Dolomite (Magnesite)

Production is the tonnage of crude material sold by primary producers, plus the tonnage of calcined or dead-burned material sold or used by primary producers. The value is that reported by the producers.

Marl

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Mica

Production is recorded as shipments from plants dressing new mica and exported shipments directly from the mines. The value of shipments is taken as reported by operators.

Nepheline Syenite

Production of crude and ground nepheline syenite is the amount of the various grades shipped at the total selling value, f.o.b. works, less container costs.

Peat

Production comprises crude peat shipped to Canadian nonproducers as fuel or for export, baled peat shipped, and the peat content of mixed products shipped. The value is sales, f.o.b. works, less the cost of containers.

Phosphate

Production is shipments from the plant. Values are f.o.b. plant, as reported by the producer.

Potash

Production represents producers' shipments of various grades from the plant and is measured as the K_2O equivalent. The value of shipments, f.o.b. plant, is reported by the producers.

Potassium Sulphate

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Pumice

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Quartz (Silica)[1]

Production represents the tonnage of crude or pulverized quartz, quartzite, pure silica sand, or other natural silica material shipped for sale, plus the tonnage of any of these materials used by producers. The value is taken as reported by producers.

Salt

Production is taken as the tonnage of various grades of dry salt shipped by primary producers, plus the salt content of brine used by producers for industrial (chemical) purposes. The value is that reported by producers.

Sand and Gravel[1]

Production represents shipments of natural gravel, sand and crushed gravel at the values reported by operators of sand and gravel pits or dredges.

Serpentine

Production represents producers' shipments of various grades, valued f.o.b. plant, as reported by the producer.

Soapstone, Talc, Pyrophyllite

Production comprises crude, ground or sawn soapstone shipments; crude, milled or refined talc shipments; and crude or ground pyrophyllite shipments. All shipments are f.o.b. the mill or plant and are valued by the shipper.

Sodium Sulphate

Production is the tonnage of crude or refined natural sodium sulphate shipped at its selling value, f.o.b. shipping points. The figures exclude the sodium sulphate produced as a by-product of paper or rayon manufacturing.

Stone[1]

Production represents quarry shipments of crude or non-dressed stone, crushed stone and dressed stone, if the latter is prepared by the quarry operators at values as reported by the operators. The figures include data for both private and public or municipally owned properties. Production figures do not include dressed stone prepared from imported stone or prepared from domestic stone in works not at the quarries.

Sulphur in Smelter Gas

Prior to final metal recovery, sulphide concentrates are smelted or roasted and the resultant gases may be used to produce marketable sulphur, sulphur dioxide or sulphuric acid. Production is considered as the sulphur content of sulphuric acid made, sulphur dioxide marketed and sulphur shipped. This sulphur is valued at the average price for sulphur sold in acid. Production is shown by the province/territory of origin of concentrates.

Sulphur, Elemental

In the western provinces, sour natural gas is processed to remove hydrogen sulphide, which is further reduced to yellow elemental sulphur. Sulphur recovered from the refining of Canadian crude petroleum is also included. Production is shown by the province/territory of origin of material and values are as reported by the shippers.

Titanium Dioxide

Ilmenite ore is smelted at Sorel, Quebec, to produce a slag containing titanium dioxide. Production is the titanium dioxide content of slag valued by the producer.

Tremolite

Production is shipments of various grades at the selling values, f.o.b. shipping point, less the value of containers.

Zeolite

Production is shipments from the plant. Values are f.o.b. plant, as reported by the producer.

Fuels

Coal

Production figures are equal to shipments from the mine/plant plus "own" consumption as valued by shippers, f.o.b. mine/plant.

Natural Gas

Production figures represent sales of natural gas from dry gas fields after field uses, losses and reinjection, but before inventory changes. Values are as reported by the producers.

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[1] To avoid duplication in computing a total value for Canadian mineral production, the quantity and value of gypsum, silica, stone, and sand and gravel used in the manufacture of lime, cement and clay products are not included in the totals for gypsum, silica, stone, and sand and gravel production. These particular data are recorded separately and are published in conjunction with data for the lime, cement and clay industries.

Natural Gas By-Products

Production figures for propanes, butanes, etc., represent the quantity that is available for market. It is the quantity produced by gas processing plants after processing and reprocessing plant uses, losses and shrinkage. Values are selling value, f.o.b. shipping points.

Oil, Crude and Equivalent

Production figures represent the production of crude oil from both conventional and non-conventional sources after field use, losses and reinjection. Values are those reported by shippers, f.o.b. well head or plant.

VALUATION OF TRADE DATA

(Note: The following has been extracted from Statistics Canada catalogue no. 65-003-XPB)

For Customs purposes, imports are recorded at values established according to the provisions of the *Customs Act* which, since January 1, 1985, reflects valuation methods based on the General Agreement on Tariffs and Trade (GATT) Valuation Code System. It generally requires that the value for duty of imported goods be equivalent to the transaction value or the price actually paid.

To determine the transaction value of imported goods, all transportation and associated costs arising in respect of the goods being appraised prior to and at the place of direct shipment to Canada are to be added to the price of the goods. Therefore, Canadian imports are valued f.o.b. (free on board), place of direct shipment to Canada. The value excludes freight and insurance costs in bringing the goods to Canada from the point of direct shipment.

To countries other than the United States, exports are, in principle, valued or recorded at the values declared on export documents, which usually reflect the transaction value, i.e., actual selling price, or in the case of a non-arm's-length transaction, the transfer price used for company accounting purposes. Canadian exports to overseas countries are valued at f.o.b. port of exit, including domestic freight charges to that point, but net of discounts and allowances. As of January 1990, Canadian exports to the United States are valued f.o.b. point of exit from Canada. Prior to 1990, they were valued f.o.b. place of lading net of freight charges, discounts and allowances.